The Peripheral Connection: Enhancing Your 64

COMPUTE!'s GAZETTE

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March 1985
Issue 21, Vol. 3, No. 3
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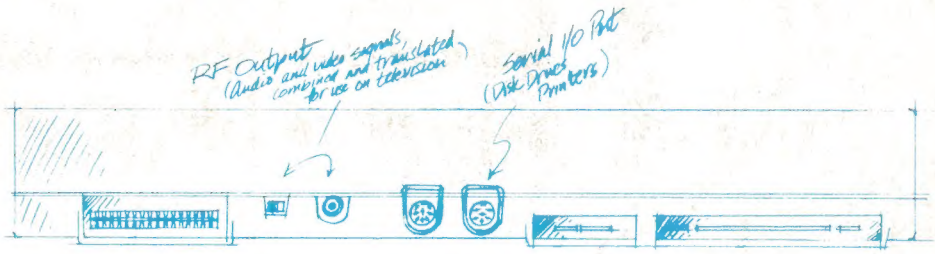

Also In This Issue:

Computing For Families

Machine Language For Beginners: Memory

Disk Handler

Software Reviews

And More

Commodore Peripheral Ports

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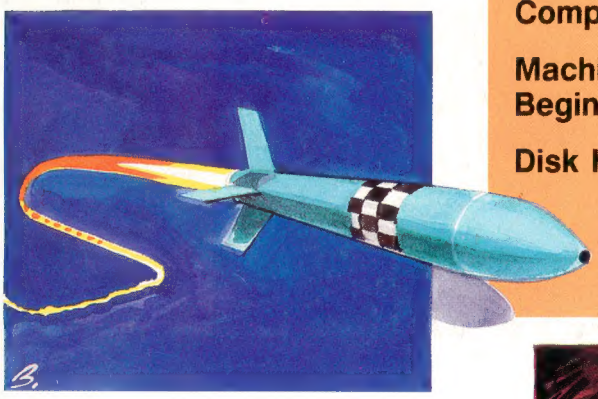

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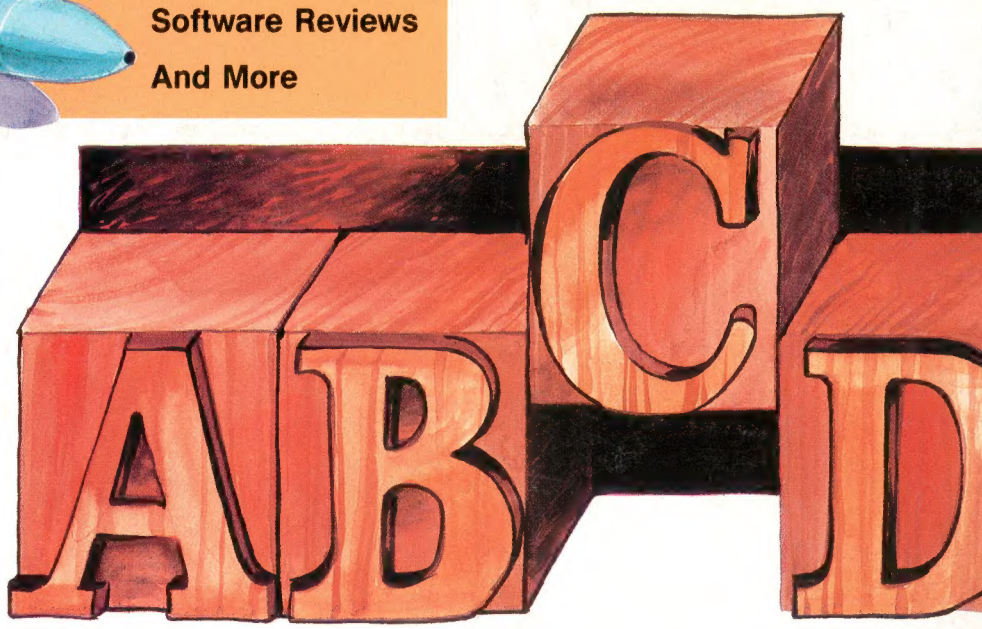

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BIDIRECTIONAL PRINT	YES		NO	YES	YES	NO	YES
(COLUMN WIDTH)							
40 CHARACTERS PER LINE	YES	40 CPL	YES	YES	YES	YES	YES
80 CHARACTERS PER LINE	YES	80 CPL	YES	YES	YES	YES	YES
66 CHARACTERS PER LINE	YES	66 CPL					
132 CHARACTERS PER LINE	YES	132 CPL					
(PAPER HANDLING)							
FRONT LOADING FOR EASY PAPER SETTINGS	YES						
BUILT-IN PRINTER STAND	YES						
PRINT ON POST CARDS	YES						
(WARRANTY)							
ONE-YEAR WARRANTY	YES						
(SOFTWARE COMMANDS)							
DOUBLE STRIKE	YES	DOUBLE STRIKE					
EMPHASIZED	YES	EMPHASIZED					
COMPRESSED	YES	COMPRESSED					
UNDERLINE	YES	UNDERLINE					
SUPER/SUBSCRIPTS	YES	SUPER SUB SCRIPTS					
ITALICS	YES	ITALICS					
DOUBLE DENSITY BIT IMAGE	YES						
(CHARACTERS)							
9X9 FONT	YES						
TRUE DISCENDERS	YES	abcgjpqyabc					
ITALICS	YES	ITALICS					
COMMODORE GRAPHICS	YES		YES	YES	YES	YES	YES
(OTHER FEATURES)							
SINGLE DENSITY BIT IMAGE	YES		YES	NO	YES	YES	NO
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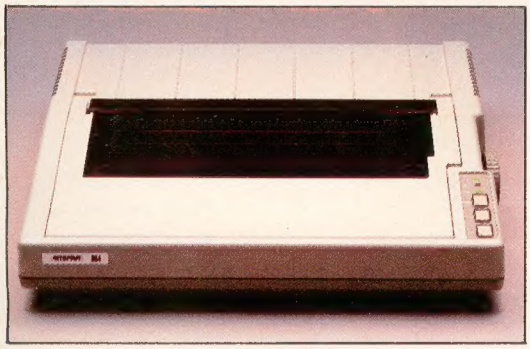

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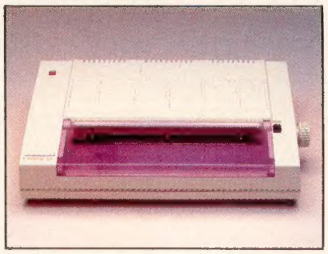

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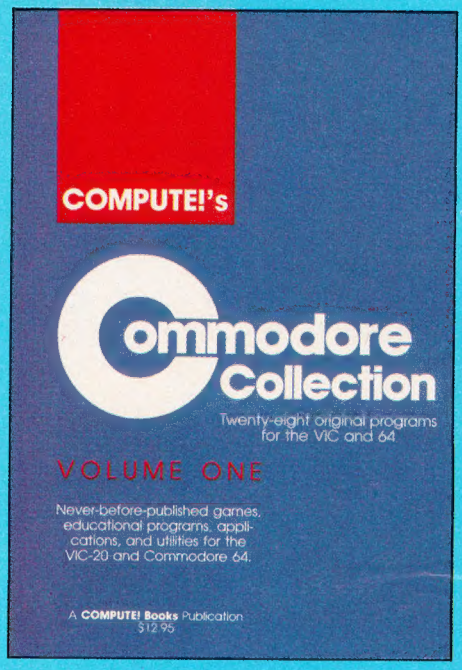
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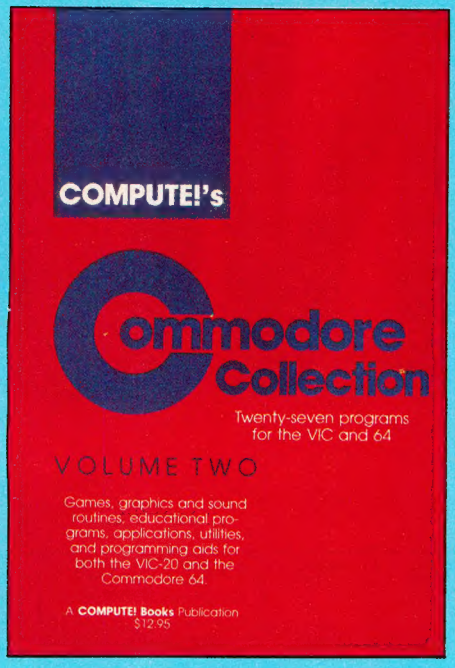
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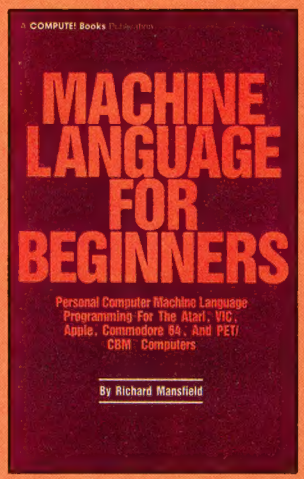
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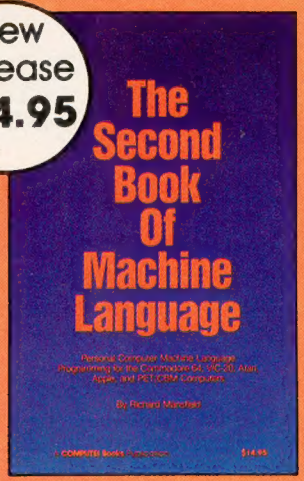

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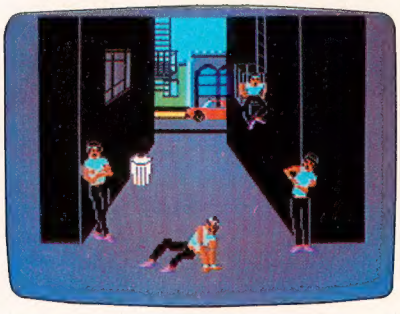

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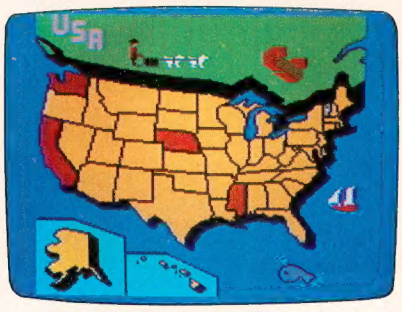

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THE EDITOR'S *notes*

Gazette Editor Lance Elko contributes an editorial this month.

Robert Lock, Editor In Chief

Anticipation is high on the eve of the Winter Consumer Electronics Show. The home computer industry, mired in a sales slump for the past several months, needs a boost, and this CES promises to reveal the direction of the market for the months ahead. There will surely be surprises. Next month, we'll have a first-hand report on the show.

With the introduction of new Commodore computers in 1985, it will be interesting to see how they're marketed. Commodore recently hired a new vice-president of marketing, Frank Leonardi, an ex-Apple marketing strategist.

We can look forward to at least three new machines from Commodore: the Amiga Lorraine (probably fall or winter), the C-128, and the surprise LCD lap (or "notebook") computer. The latter two are expected to be introduced at CES. Unlike Commodore's past ventures with new computers, the lap computer (officially nameless at this writing) was not subject to premature announcements and conjecture. With 32K usable RAM, the lap computer goes one better than many of its competitors. It's powered by four AA alkaline batteries, has non-volatile memory (you don't have to save files with storage devices—they stay in the machine), is programmable, and contains an LCD display with 80 columns and 16 lines. It contains seven built-in programs: a word processor, file manager, spreadsheet, scheduler (with programmable alarm), calculator, memo pad, and address book. And all are integrated.

A 300-baud, auto-answer, auto-dial modem is built in, and RS-232, Centronics parallel, and Commodore serial ports are included. Commodore BASIC 3.6 (a slightly enhanced version of the BASIC in the Plus/4 and 16) and a machine language monitor are resident. We'll have a hands-on report next issue.

Looking Ahead

In the months ahead, we're planning some changes in the GAZETTE. Beginning with the April issue, we'll take a different approach in the "Reviews" section. We'll review more products, but, so as not to sacrifice space, in shorter and tighter coverage. The "News & Products" section will undergo a similar change. Also, next month is the final appearance of one of our regular features, "Inside View." However, we will continue to print relevant and interesting interviews as appropriate for feature articles.

Also in the works are a variety of outstanding programs and articles which you won't want to miss: "MetaBASIC," a powerful utility that adds 32 commands to BASIC; "ProBASIC," which takes the pain out of programming sound and sprites, plus much more; some interesting telecommunications items; excellent tutorials and programs on sorts and program crunching; and some of the best games we've ever offered. Plus a few surprises. See you next month.

Lance Elko
Editor

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GAZETTE FEEDBACK

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One Action At A Time

How can you make more than one thing happen on the screen at one time—for example, a joystick-controlled sprite, a laser sprite triggered by the fire button, and background music, all at the same time?

Walter R. Klis

Computer games might seem to do many things at once, but they're actually doing only one thing at a time. Computers follow instructions sequentially, one after another. A system that does several different things at once is possible, but you would need more than one computer or microprocessor (each operating sequentially).

To give your program the appearance of simultaneous action, you need to plan ahead. Separate the actions into subroutines. IF-THEN can decide whether or not you want to GOSUB to the appropriate routine. It might help to write, in plain English, the conditions and their consequences. For example,

IF (button is pressed) THEN (launch laser and set laser flag)
IF (joystick move) THEN (move ship sprite)
IF (one second has passed) THEN (play another note of the song)
IF (laser flag is set) THEN (move laser sprite again)
REPEAT (the above loop)

First, you check for the joystick button. If it's pressed, GOSUB to the appropriate routine. If not, you forget about launching the laser until the next time through the loop. Once you've launched the laser, you want it to continue moving, which is the reason for the laser flag. Whether or not the button was down, you next PEEK the joystick to see if the player wants to move, and update the ship's position. Third, you check the jiffy clock, the variable TI or TI$, to see how much time has gone by. If a second (or whatever time period you've chosen) has passed, play the next note of the song. Next move the laser sprite, if the flag is set, and go back. The program loops around and around, checking the joystick twice, the time, and a variable, taking any necessary actions.

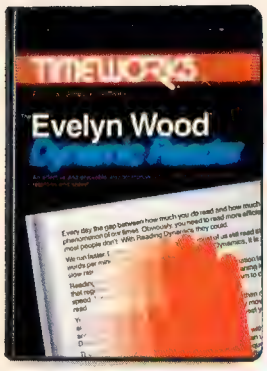
The computer works quickly, so the individual actions seem to be coordinated, all happening simultaneously.

To convert the above outline into a playable game, you would need a few more subroutines. One would check the collision register, in case the laser has hit something. Another would erase the sprite and unset the flag as soon as the laser reaches the top of the screen. And, of course, you'd have to translate the outline into BASIC.

There's another technique which is even closer to simultaneous action. But it requires an intermediate to advanced knowledge of machine language (ML). Sixty times a second, the computer stops what it's doing and takes some time to redraw the image on the screen. The main program is being constantly interrupted. Using a wedge, *you can divert the interrupt to your own ML program which could play music, move sprites, or whatever you choose. Such* interrupt-driven *routines are sometimes difficult to implement, but can be very effective.*

Breaking And Entering

I'd like to know if there is a terminal program that would allow someone calling my computer



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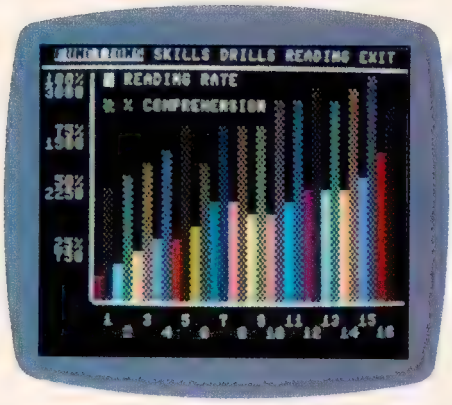

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to take control of it—being able to catalog the disk in my drive, for example.

Timothy Yates

If you think other modem users might call your computer and get information about what's on your disk, don't worry. If the computer is turned off, no one can break into your computer (unless they break into your house first).

On the other hand, if you do want to upload your directory (to a friend, for example), there are a couple of ways to do so. It's unlikely, but your terminal program may allow you to send a directory to your friend—check the documentation to be sure. Or you can create a program file which contains the current directory. Before you go on-line, load the directory (LOAD"$",8) and then save it back to the disk under another name. Then you can upload the file (which contains the directory information) to your friend. In either case, you, *not your friend, would be controlling the computer.*

Also, many bulletin board systems are designed to allow remote users access to the disk directory of the host system. The system operator (sysop) usually controls which files can be accessed by users. Again, the users don't actually take control, rather they are permitted to read the directory. Bulletin board systems are specialized terminal programs which allow the caller to save or load files and messages to or from the host disk. Once you connect to these systems, you typically select from several options and the bulletin board program reacts by accessing the disk.

Write-Protected GAZETTE DISKs

I ordered your August 1984 GAZETTE DISK, which featured "Sprite Magic." The disk is write-protected, so I can't save any of my pictures. Please tell me how I'll be able to save things with "Sprite Magic."

Jason Miller

Insert another disk in the drive before responding to the final prompts to save in "Sprite Magic." By the same token, insert the disk with sprite data if you wish to load previously saved sprite data back into Sprite Magic.

From May through the first disks of August there was a notch in the GAZETTE DISKs. *Users could read from and write to the disk. We began to write-protect (no write notch on the disk)* GAZETTE DISKs *with the later versions of the August disk. This was done in the interest of safety. "Disk Purge," the first program on the menu of the August disk, deletes disk files. Some disk subscribers received their disks and ran the program without reading the article, deleting programs from the* GAZETTE DISK.

We encourage GAZETTE DISK *buyers to make backup copies of their disks. Although our disks are write-protected, they're not copy-protected. You can save any BASIC program to another disk with the usual SAVE "*filename*",8. If you want to save a machine language program (such as "Sprite Magic"), you'll need a special utility program. We've published several such utilities: Program 4, "Machine Language For Beginners," (December 1984* GAZETTE*); "File Copier" (April 1984* GAZETTE*); "Single Drive Copy" (September 1983* GAZETTE*); and "Unicopy" in the October issue of our sister magazine,* COMPUTE!*. You can also use MLX to copy ML programs. You might want to make a separate copy of any programs which create new files (such as "Sprite Magic") so you won't have to continually swap disks.*

Quashed Question Marks

Is there any way to INPUT information without getting those stupid question marks? I tried using GET statements and adding them together, but you can't see the cursor.

Coleman Nee

GET is one of the ways to avoid seeing question marks, as you've noted. The advantage to GET is that it accepts all characters, including commas and colons, which aren't normally allowed in INPUT statements. And it is possible to make the cursor blink during a GET statement.

But there's a better way to turn off the question mark. Closely related to INPUT, the INPUT# command allows you to retrieve information from a previously opened file or device. And it doesn't print question marks.

Since the keyboard is device zero, you can open a file to the keyboard and use INPUT#:

```
10 OPEN1,0: INPUT#1,A$: PRINT A$: CLOSE1
```

It won't accept null input (typing RETURN), nor will it accept spaces by themselves. You can *include spaces between words. Like INPUT, it will read anything up to a comma or colon, but (unlike INPUT) won't give you back an ?EXTRA IGNORED error.*

MLX Upgrades

The MLX program has been a great help in typing machine language programs. When version 2.02 came out, I typed it into my 64 and it ran fine until I tried to save a program to tape. It kept saying "Error On Save. Try Again." I compared an older version to the new one and found a new line 766, with K=E+1. Does this "+1" serve some purpose I don't know about?

Diane D. Junes

Between December 1983 and December 1984, the GAZETTE *has published four versions of MLX (plus*

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one which ran once in COMPUTE! *Magazine). Version 1.00 (December '83 only) had three lines which were too long to enter into a 64 without abbreviations. MLX 1.01, not much different from the original version (except for splitting the long lines in half), ran in the first half of 1984.*

To save ML programs, you must specify the starting address and the ending address (plus one). The first two versions of MLX did not add one to the ending address, resulting in problems with some programs like "BASIC Aid." That's why line 766 was added.

MLX version 2.00, in the March issue of COMPUTE! *(our sister magazine) fixed the ending address problem, but did not save the first byte of the program. Version two also added a numeric keypad option and a disk save-with-replace.*

Versions 2.01 (first in the July GAZETTE*) and 2.02 (November) are essentially the same. Both correctly save the beginning and ending address, both have a numeric keypad, and both scratch-then-save (rather than use error-prone save-with-replace). The only difference is a slight change in line 300, to remove the vestiges of sprite graphics from the original MLX. Versions 2.01 or 2.02 are reliable, and we recommend you use one of them rather than the earlier versions.*

Disk Files

What's the difference between disk files like PRG, SEQ, REL, and USR?

Bob Ideker

The 1541 Disk Operating System (DOS) provides for five types of disk files: PRoGram Files, SEQuential Files, USeR Files, RELative Files, and DELeted Files.

When you save a program, your computer has to read through program memory and send information through the cable to the disk drive. The drive could put the program anywhere on the disk, but you wouldn't want it to overwrite other programs or files. So the Disk Operating System has to keep track of where the programs or other files are. It puts the name of the file into the disk directory, marks it as a program, looks at the Block Allocation Map (BAM) to find some free space on the disk, and then saves the program.

A program file (PRG) is just what the name implies. It's information that was saved as a program. It could contain a BASIC or machine language program. Or it might be a section of memory transferred to disk using the SAVE routine in BASIC (SpeedScript *and* WordPro, *for example, both save text to disk as PRG files). To get the program back into the computer, you use the LOAD command. LOAD works only on PRG files.*

A sequential file (SEQ) is most often used for storing information such as mailing lists, inventories, etc. Instead of SAVE, you use OPEN, PRINT#, and CLOSE to write to the file. To read it, you must OPEN, INPUT# or GET#, and CLOSE. Information in such files is accessed sequentially, one item after the other, starting from the first entry in the file. So to get to item number 319, you would have to read through the 318 prior entries.

Relative files (REL) are also used to store information. They're harder to work with, but can save a lot of time when you're working with many files. Such files are accessed with the OPEN command, but the data records are numbered, so before you read in the data, you have to position a pointer. This allows you to home in on the desired record. To reach record number 319, you just set the pointer to 319 and the disk drive finds it right away (rather than having to search through all of the previous records). Relative files are faster than sequential files for individual records and do not require much of the computer's memory, as the entire file is not read into memory. An unexpanded VIC with 3.5K of memory can manage up to 163K of information using relative files.

USR files have a very specialized purpose and you'll rarely see them in use. You can OPEN and write to them as if they were sequential files (replacing the S for sequential with a U for user). And since the Validate command scratches random files, some programmers will create dummy USR files to protect data written directly to disk. There's also a machine language technique for writing DOS programs into USR files.

A deleted file (DEL) is one which no longer exists in the directory and has no blocks reserved for it in the BAM. When you scratch a program or file from the disk, it is not actually erased. The directory entry is marked as a deleted file and the BAM is updated, to de-allocate the space formerly used by the program. The file still exists on the disk—at least until you write other information to the blocks occupied by that file. By using a disk editor, you can change the byte in the directory which indicates a deleted file back to the original value, then VALidate the disk (OPEN 15,8,15: PRINT#15,"V0":CLOSE 15) to update the BAM and restore the file. If other files have been saved on the disk since scratching the file, you may not be able to restore the file.

Searching For Zero-Page Locations

I own a Commodore 64 and I discovered that each time I store a value in a zero-page location, the computer crashes. I'd like to know what zero-page locations are free for the programmer, if any.

Yoav Ben-Yosef

Zero page (locations 0–255 ($00–$FF)) is used heavily by the computer as a "scratch pad" for stor-

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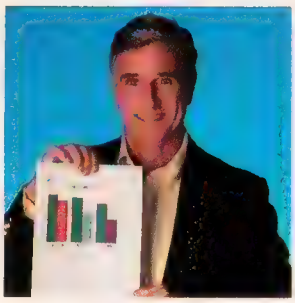

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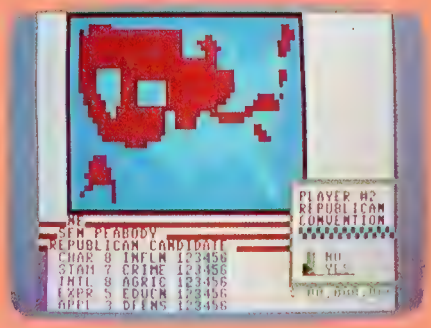

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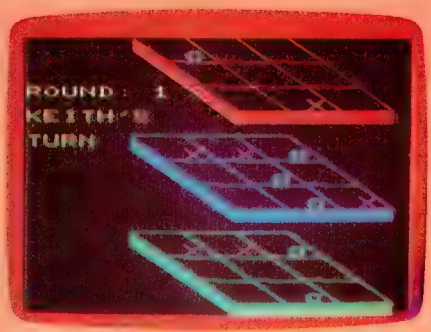

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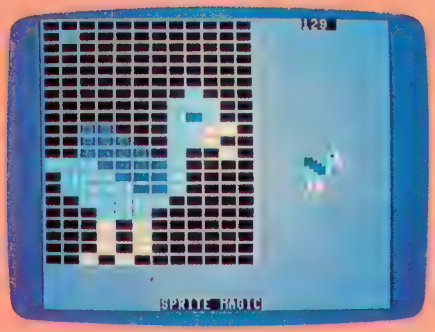

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ing important information. It's also a favorite area of memory with machine language programmers because programs which use zero page take up less memory and execute faster than those that use other areas of memory. And there is a zero-page addressing mode which requires the use of zero-page addresses.

The popularity of zero page sometimes leads to memory conflicts. If you're not careful, you may be trying to use a location that the computer is already using for something else. This can cause the computer to act strangely, forcing you to turn it off and back on to regain control.

Fortunately, the 64 doesn't use all of zero page. Locations 2–6 ($02–$06) and 251–254 ($FB–$FE) are always free. Other locations are free only under certain circumstances. For example, locations 139–143 ($8B–$8F) are free as long as you don't use the BASIC RND function. If your ML program doesn't need BASIC at all, locations 7–143 ($07–$8F) are free. If you don't need the Kernal, locations 144–250 ($90–$FA) are free.

If your ML program uses BASIC and the Kernal and needs lots of zero-page space, you can use any location as long as you restore that location to its original value before returning to BASIC. The easiest way to do this is to have your ML program move the entire contents of zero page to a safe area of RAM before executing, and then move it all back just before returning to BASIC.

For a detailed discussion of each zero-page location, see COMPUTE!'s Mapping the Commodore 64 *or* COMPUTE!'s Mapping The VIC.

Printing Pennies

I've been writing programs which use a lot of dollars and cents. My problem is, how do I get $12.50 instead of $12.5? The zero never shows.

Chuck Stehley

Some versions of BASIC, including BASIC 3.5 on the Plus/4 and 16, offer a PRINT-USING command. You define a format for numbers or strings, in effect forcing the computer to print pennies or dollar signs.

One way to include pennies on a VIC or 64 is to first multiply by 100, to put in the zeros. Then convert the number to a string and insert the dollar sign and decimal point.

```
10 A=12.5
20 B=INT(A*100): B$=STR$(B): L=LEN (B$)
30 PRINT"$"; LEFT$(B$,L-2); "."; RIGHT$(B
   $,2)
```

In line 20, the number 12.5 is multiplied by 100 to get 1250, then converted to a string " 1250" (the space in front would be a minus sign if the number were negative). Line 30 prints a dollar sign, all but the last two characters of B$, a decimal point, and the last two characters.

Also, the Commodore 1526 printer has the equivalent of PRINT-USING. If you own a 1526, you can use the built-in formatting commands (use a secondary address of 2) to automatically print trailing zeros and align the numbers into columns.

A Printer's Gremlin

I'd like to know why sometimes when I have deleted something and hit RETURN, the cursor does not take its normal position, but jumps over to the right, past the last word on the line.

C. M. Woods

Without knowing the full details of the situation, we can only guess what's wrong.

You may have listed a program to the screen and then listed it to a printer (OPEN4,4:CMD4:LIST) without properly closing the file to the printer afterwards. Try to edit a line on the screen, and the cursor will act as you have described. The thing to do is close the printer file (PRINT#4:CLOSE4). The cursor will be back to normal. The same thing may happen if you've used CMD to send output to another type of file—a cassette or disk drive, for example. Always remember to close files you have opened.

Going Off-Line With Gemini

I'm using a Gemini 10-X printer interfaced to my Commodore 64 with a CARDCO +G interface. The Gemini manual indicates that the printer can be turned on- and off-line using CHR$(17) and CHR$(19), respectively. Using *SpeedScript*'s print command, CTRL-P, these commands do not work. But using the SHIFT-CTRL-P command, selecting device 4 and secondary address 4, these commands work. I also have to place a reverse video *a* (CTRL-£ a) at the beginning of the file to get the proper upper- and lowercase lettering.

The commands are useful, for example, when you want to edit the tenth page of a document, and print from that point to the end. The off-line command is placed in the document wherever you want printing to cease—at the beginning in this case. Print the document to the screen once to determine where the page begins. To resume printing, place the on-line command followed by a form feed code, at the place you want to start printing—just after the last character of the previous page. If the last character of the previous page is a return character, place the command codes before it.

Larry Holloway

This useful tip can be used with other interfaces as well, and with some other printers (consult your manual). And it should work with word processors other than SpeedScript, *as long as the word processor allows you to send ASCII characters 17 and 19*

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and your printer recognizes these as commands for going on-line and off-line. Commodore printers do not have this feature.

The secondary address of four is for the Cardco graphics (or transparent*) mode. Use the correct secondary address for your interface, and remember that some interfaces require you to send commands in unusual ways.*

To print to the screen so you can preview the page breaks, use the SHIFT-CTRL-P command followed by device 3 and secondary address 3. Use of the above codes requires you to use the reverse video numbers, which can be assigned values in SpeedScript. *At the top of the file, define three of the reverse video numbers to the desired values, 17, 19, and 12 (for form feed).*

For example, to define the form feed command, use [5]=12. (The brackets represent a reverse video number, obtained by pressing CTRL and £ simultaneously, followed by the number 5.) If you define [6]=17 and [7]=19, you would insert [7] to stop printing, and [6][5] to resume, with a form feed. You may have to experiment to get the results you want. Remember that SpeedScript *doesn't know what you're doing, so the printout can look strange in some cases. For example, when you send the code to go back on-line followed by a code for a form feed, the printer knows to go to the top of the next page, but as far as* SpeedScript *is concerned, the form feed was just another character.* SpeedScript *might think it's printing the middle of a page, and headers and footers will print incorrectly.*

Long Tapes

Do you really think that cassette tapes over 30 minutes will affect the Datassette?

Rick Stockhorst

No, long tapes probably won't do any harm to your cassette drive. But you might want to consider some of the reasons not to store programs and data files on them.

Tapes over 30 minutes are generally thinner and less reliable than shorter tapes. And it's harder to find the right spot on the tape; you may have to wait for a while before a program is located. Tapes should be tightly wound, and a long tape is more prone to slip and slide, leading to loss of data; the solution is to fast-forward and then rewind the tape, which (again) takes time.

Finally, think what would happen if the tape was lost or destroyed. Loss of a long tape with many programs could be a disaster, especially if you don't have backup copies.

The RESTORE Key

I own a VIC-20 and now have a Commodore 64. I've had problems using the RESTORE key. On the VIC-20, it worked every once in a while, and on the 64 it doesn't work at all. In the User's Guide, it says SYS 64759 will restore the computer to the state of just being turned on. Is there a SYS number that does the same thing as RESTORE, but doesn't erase the program in memory?

Allen D. Brewer

Unlike any other key on the keyboard, RESTORE is wired directly to the chip that controls your VIC or 64. When you tap RESTORE, the computer checks to see if RUN/STOP is being pressed. So you must hold down RUN/STOP before pressing RESTORE.

On a VIC, RUN/STOP–RESTORE works well, but on a 64 you may have to smartly tap the RESTORE key. Gently pressing it doesn't always do the job, for some unknown reason.

Your 64 User's Guide contains a misprint—SYS 64759 does not perform a cold start. That particular SYS enters the cold-start routine from the wrong place and eventually hits a BReaK (BRK) instruction (see below). The Programmer's Reference Guide correctly lists the cold-start routine—SYS 64738 (SYS 64802 on a VIC). The Commodore Plus/4 and 16 do not have a RESTORE key. On those computers you have to hold down RUN/STOP and press the reset button on the right side. You'll end up in the built-in machine language monitor (type X to exit back to BASIC).

The cold-start SYS will erase the program in memory (although you can get it back with an UNNEW program). RUN/STOP–RESTORE leaves the program intact in memory. Its equivalent in machine language is the BRK instruction, with a value of zero. SYS to a memory location that holds a zero and the computer will perform a RUN/STOP–RESTORE. For example, **POKE 828,0: SYS 828**.

Self-Modifying BASIC Programs

Is there a way to make a program write its own DATA statements from user input?

Todd Swearingen

Yes, you can write a program that changes itself via the dynamic keyboard *technique.*

To understand how it works, you should know that Commodore computers have two different types of carriage returns. In program mode (when a program is running), printing a CHR$(13) carriage return moves the cursor to the beginning of the next line. But that's all it does: move down a line. But in immediate mode (when you're writing a program), RETURN moves the cursor to the next line and *does one of two things. If there's a number at the beginning, the line is added to the BASIC program in memory. If not, the commands you typed are immediately executed.*

Thus, to write a program that adds DATA

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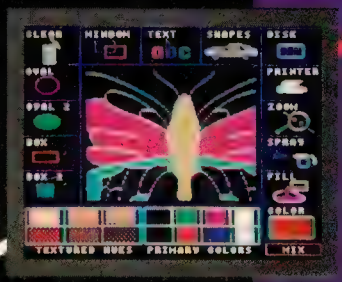

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statements to itself, you have to toggle back and forth between the two modes. You print to the screen in program mode, END the program, and have the computer automatically hit RETURN over the lines. The following program illustrates:

```
10 DL=1000
20 D$="DATA"
30 INPUTA$
40 PRINTCHR$(147);DL;D$;A$
50 PRINT"10 DL=";DL+1
60 PRINT"RUN"
70 POKE631,19:POKE632,13:POKE633,13:POKE6
   34,13:POKE198,4:END
```

Lines 10–30 define two variables and input an item which will be added to the program. Line 40 clears the screen and prints the line number (DL), "DATA", and the user input. Line 50 prints a new line 10, where DL is increased by one (for the next time). Line 60 prints "RUN".

The dynamic keyboard technique happens in line 70. Four numbers are POKEd into the keyboard buffer (ten memory locations from 631 to 640) and a 4 is POKEd into 198 (which keeps track of how many keys have been pressed). Then the program ends.

The computer switches from program mode to immediate mode, and it thinks four keys have been pressed. The first key is HOME (CHR$(19)). The next three are carriage returns (CHR$(13)). The carriage returns are the kind we want: They'll add the lines to BASIC memory. A DATA statement is entered, line ten is changed, and RUN is executed. The program loops back to get more input. Press RUN/STOP–RESTORE to get out of the INPUT statement and end the program. Then save the program, which contains the newly created DATA statements.

The dynamic keyboard technique can do more than add DATA statements. You can use it to erase a block of lines from a program by printing a CHR$(13) over a series of line numbers.

Printing Characters In Machine Language

I've been trying to put Commodore or ASCII characters into screen memory in machine language. I've converted the POKE values into hexadecimal and then "stored" the value into the screen location. But I always get characters that are wrong. How do I solve this problem?

Drew McKenna

You've got the right idea, and it should work. A machine language store instruction works just like the POKE command in BASIC.

When you're writing a machine language program, it often helps to think about how you would do something in BASIC, and then translate the idea into ML. BASIC and machine language are not as different as you might think.

There are a couple of ways to put a character on the screen in BASIC. You can do a POKE to screen memory, followed by a POKE to color memory. Or you can use the PRINT command. Both options are available in machine language.

In BASIC, to POKE a yellow letter A into the upper lefthand corner of the screen on the 64, run the following program:

```
10 POKE 1024,1: POKE 55296,7
```

The equivalent in ML is:

```
828  LDA #1
830  STA 1024
833  LDA #7
835  STA 55296
838  RTS
```

Or, in hexadecimal:

```
033C LDA #$01
033E STA $0400
0341 LDA #$07
0343 STA $D800
0346 RTS
```

Once the ML program is in memory, SYS 828 to activate it.

First, using the LDA/STA method, you have to store a value into both screen and *color memory, just like BASIC. And if you're SYSing from BASIC, you have to end the ML program with an RTS (ReTurn from Subroutine), which is similar to a RETURN in BASIC. The LoaD Accumulator (LDA) instruction has many different addressing modes. LDA #$01 puts the actual value $01 into the accumulator. LDA $01, on the other hand, will take whatever value is in location 1 and put it in the accumulator. This may be the cause of your problems.*

The number sign (#) after LDA is important, signaling you want the value one. Also, some ML monitors or assemblers allow either hex or decimal numbers. You may have to mark hex numbers with a dollar sign, as in the example above.

Finally, there are two numbers for the letter A, just like in BASIC. If you're POKEing (LDA followed by STA in machine language), you use 1, the screen code. *But if you're printing, you print a CHR$(65), the* ASCII value.

To print in ML, you do a JSR to $FFD2. As an alternative to the above program, try this:

```
033C LDA #$41
033E JSR $FFD2
0341 RTS
```

Again, SYS 828 makes the program run. Hexadecimal $41 is the same as decimal 65 (the ASCII value of "A"). When you Jump to SubRoutine (JSR) $FFD2, the letter A is printed to the screen in the current cursor color. $FFD2 is a Kernal entry point for PRINT. The Kernal routines occupy the same locations on the VIC, 64, and Plus/4 computers.

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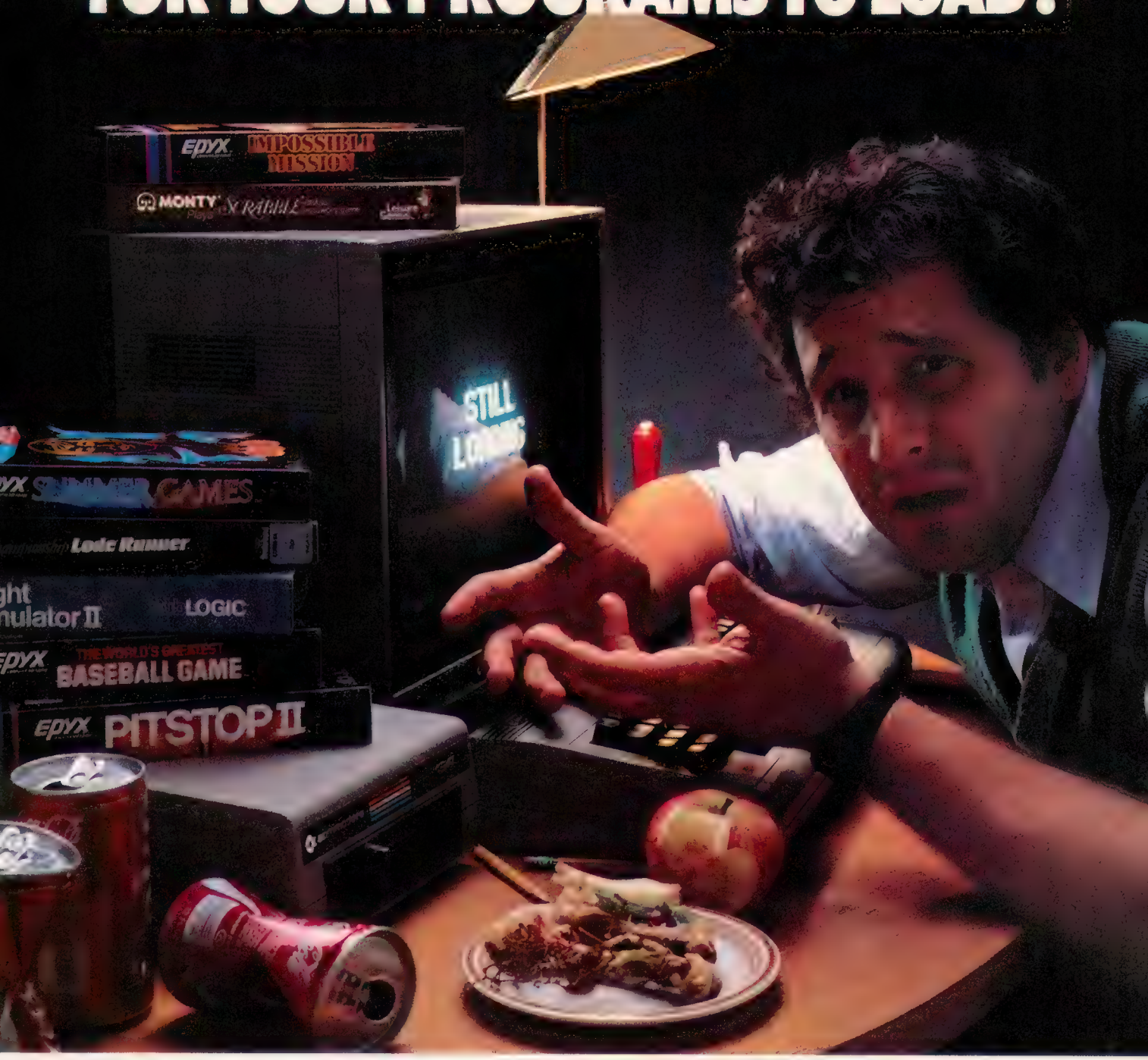

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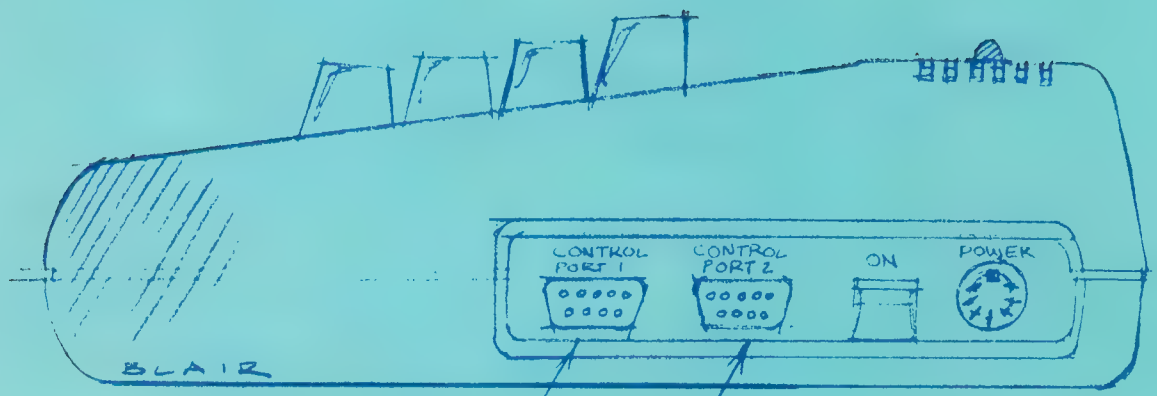

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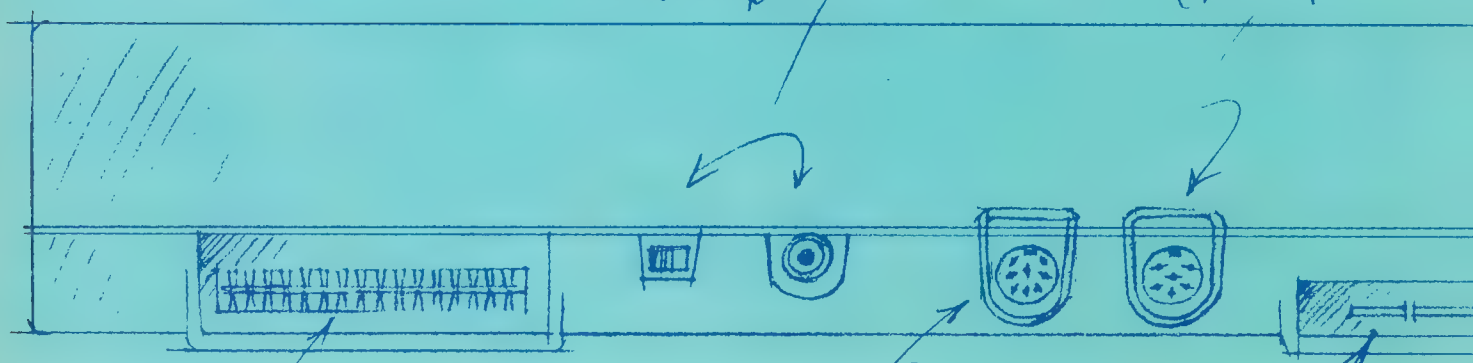

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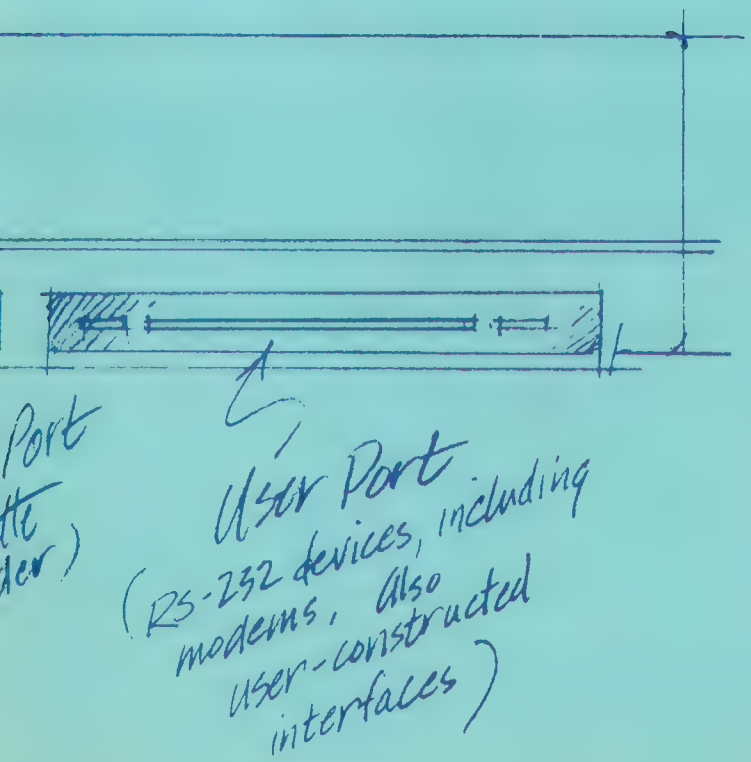
THE PERIPHERAL CONNECTION

ENHANCING YOUR 64

Selby Bateman, Features Editor

Peripherals can bring much more power and flexibility to your Commodore 64. And they're available as never before. That translates into a multitude of opportunities—and changes—as you continue to enhance your computer's capabilities. Here's an overview of the expanding peripheral marketplace for the 64.



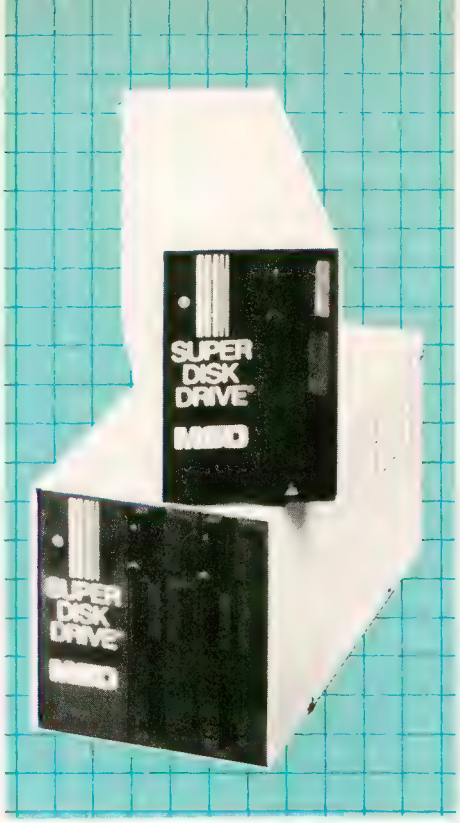
Once you've made the choice to purchase a Commodore 64 computer, your decisions begin to multiply. If you thought choosing a microcomputer to suit your needs was challenging, you'll soon find yourself overwhelmed by the peripheral options open to you. Even experienced computer owners discover it's hard to stay abreast of the rapidly growing inventory of peripherals designed for the 64.

But this proliferation of products means that some people are making mistakes, says Tom Dow, product manager for Commodore's Computer Systems Division. "It's obvious—but a very important consideration for people who are buying 64s or any computer—that they get involved with applications that are really going to benefit them. It's important for people to understand what they need

to do and get themselves plugged into a product that is best going to suit those needs." And that means *before* you make peripheral purchases which may be two or even three times the cost of the 64 itself.

Many people buy peripherals without first fully understanding what they are going to do with them, how they interact with the Commodore 64, and what software is to be used, adds Dow.

If you follow the general rule that a *peripheral* is any piece of hardware which can be plugged into your computer to enhance its function, the list of such products includes literally hundreds of items from scores of manufacturers. The good news is that there's plenty of information at hand for the discerning consumer. And the peripheral options really aren't difficult to categorize and compare if you'll take the time to think through your choices and your needs.



The MSD Super Disk drives.

There are basically five major categories of peripherals for most microcomputers, including the 64. When you begin to think about building a *system* around your computer, your choices include the following:

1. *Mass storage devices*—An absolute necessity for your computer since it is this attachment which lets you store information (on tape or disk) for later use and also allows you to run commercial software not on cartridge. For the 64, the choices have grown rapidly during the past year.

2. *Display devices*—Essentially the television set or video monitor which lets you see what you and the computer are doing together. There are surprising indications here that 64 owners are changing their preferences about what display they wish to use (more on this later).

3. *Printers*—Although printers could be listed as an alternative display device, their importance and special functions require a separate category. Commodore 64 owners have more choices here than ever before, generally at lower prices for better quality.

4. *Communication devices*—Modems (and telecommunications software) are now among the hottest items for Commodore 64 owners. The popularity of bulletin boards and the growth of major telecommunications services are changing the face of personal computing.

5. *Input devices*—There are many ways other than your computer keyboard for you to interact with the 64. Joysticks, light pens, touch tablets, and track balls are just a few. And soon, even the popular table-top controller called a *mouse* should be available for the 64.

Let's take a look at some of the changes affecting these peripheral product lines for the Commodore 64.

Commodore officials were pleasantly surprised during 1984 by a significant change in the buying patterns of 64 owners looking for storage devices. Over 90 percent of these purchases from Commodore were 1541 disk drives rather than the more inexpensive Datassette recorders.

"That was one of the things that really threw us for a loop," says Commodore's Dow. "The percentage of people who actually bought disk drives to go with the 64 was *very* high." Commodore was caught by surprise and there was a period about a year ago when 1541s were in very short supply.

Since there are some other sources for inexpensive cassette tape drives compatible with the 64, it would be wrong to presume that the 90 percent figure would apply throughout the Commodore 64 marketplace. However, the combination of low price (about $250 for the 1541), the relatively faster access times of a disk drive over tape, and the trend toward putting more and more commercial software on disk rather than cassette has dramatically altered the situation.

"For the majority of the people who purchase the 64, the first buy will be the disk drive," says Dow. "When the 64 first came out, there was a lot of software on cartridge since there was skepticism about how many people would purchase the disk drive." That is true no longer.

As any Commodore 64 owner quickly learns, the computer accesses data from a cassette tape drive in a sequential manner. The tape slides by the read/record head in a linear fashion. You can't get to the third program on a tape without winding past the first two programs. The disk drive, however, is a random access device. The read/write head can jump from spot to spot on a disk much as a record player needle can be placed anywhere on the surface of a record. Such accessibility and speed have proven too attractive for most 64 owners to ignore.

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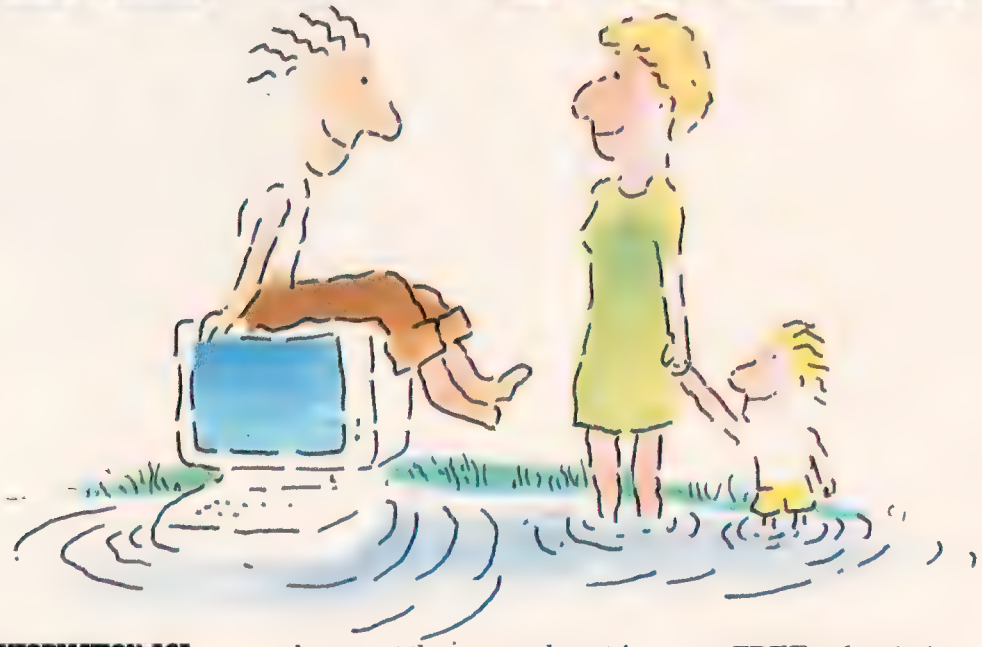

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Although the first purchase for 64 owners may be a disk drive, that doesn't necessarily mean it will be the 1541. As the installed base of Commodore 64s has increased, the peripheral marketplace has become crowded with competitors. And that includes disk drive manufacturers.

For example, MSD Systems, Inc., has developed single and dual Super Disk Drives for the Commodore 64 aimed at being faster, cooler running, and more dependable than the 1541. "It was clear to us that if we were to compete in Commodore's market, we would have to produce products of superior quality," states Jim Gragg, MSD vice president of engineering.

MSD's dual drive, the Super Disk II, is more expensive than two single Commodore drives—about $695—but will reportedly format, copy, and verify in less than two minutes what two 1541s would need 35 to 40 minutes to complete. The single-drive Super Disk I is priced at $399.

Other disk drives now available for the 64 are the $399 Indus GT from Indus Systems, which is reportedly 400 percent faster than the 1541, and the $369 Commander II from Commander Electronic Systems. Here again, as with the MSD drives, there are price/performance tradeoffs in relation to Commodore's 1541 drive.

While the competition heats up between 64 disk drive manufacturers, there is a clear move away from the slower sequential access tape drives which so dominated during the early days of the VIC-20 and 64. As the market matures, so do the tastes and demands of 64 owners.

For those who wish to use a cassette drive, Electronic Components of Elma, New York, has engineered a way for you to save even more money. Rather than buying a Commodore Datassette recorder, the company offers the Computer Patch Cord (CPC-1000), a $29.95 cord which lets you use a 64 or VIC-20 with an ordinary cassette recorder.

Another surprise for officials at Commodore last year was the popularity among 64 owners of the 1702 color video monitor. It became, on average, the next most-purchased Commodore peripheral after storage devices.

"Again, we were relatively shocked with the percentage of people who will buy the 1702," says Dow. "It boils down to a number of different reasons. Obviously, resolution is much better on the 1702 than it would be on a television set. The second thing we've found—although we give the proper hookup requirements to attach a 64 to a television set—a lot of people don't like to tie up their TV set with the computer. So by buying the 1702 monitor, it gives them the ability to have a dedicated work station without interrupting a television set."

Just as inexpensive tape drives bring you functionality at a low price, so your television set can bring you a computer's video images without additional expense. All you need to do is attach the RF modulator to your black and white or color TV, and you're in business.

Commodore 64 owners are turning toward disk drives for much the same reason they're now using dedicated video monitors in increasing numbers: greater performance for more serious applications. Especially with the rising interest in productivity programs such as word processors, data bases, and spreadsheets, owners of the 64 are more often asking for the greater clarity of a video monitor. Even on the best color television sets, an 80-column line of printed characters (now available in several word processor and spreadsheet formats for the 64) is all but unreadable. Not so with the variety of video monitors on the market from companies like Cardco, Commodore, Roland DG, Samsung, Teknika, Amdek, Sakata, and others.

Some Commodore 64 owners are opting for both color television and the high-quality of direct video monitors. Cardco's $199.95 MT/1 Monitor Tuner, for example, is a remote-controlled, 60-channel, cable-ready tuner which provides separate video and audio output matched to composite input computer monitors. It works with any color or monochrome monitor, transforming it into a television set with the flip of a switch.

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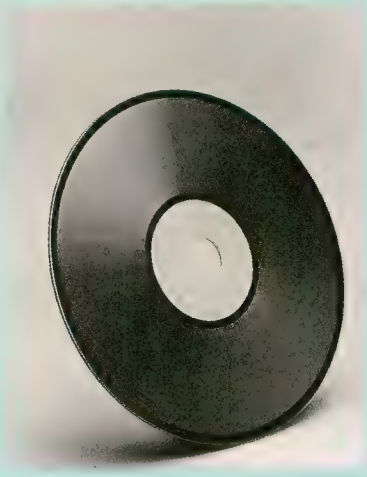
PERIPHERALS OF THE FUTURE

Sharon Darling, Research Assistant

If you've never heard of brain wave input, read/write laser disks, flat screen video, or sound sampling, you're in good company. Many of these products are still in development, still in prototype in laboratories. Nevertheless, these peripherals could add great power to your computer. Some are available now, some will be soon. Here's an overview of the next generation of input and output devices.

• **Compact disks:** The disk that is revolutionizing the recording industry can also work with computers. Current models can only act as Read Only Memory (ROM) data storage devices. Electronics giants Sony and Philips are both working on computer applications for compact disks, and Nippon Columbia of Japan has introduced a compact disk that has a storage capacity of more than 550 megabytes per side—the equivalent of 500 to 1,000 floppy disks.



Compact disks, which measure about five inches across, have the capacity to become mass storage devices for computers.

Measuring about five inches across, a compact disk uses the same type of laser mechanism as audio compact disks. Sound and data, as well as digitized images, can be stored on the disks.

However, engineers are at work on a read/write CD that would provide home computers with astounding amounts of online memory and would quickly replace current floppy disk devices.

• **Electromyograph/Brain Wave Input:** Synapse Software Corporation already sells a headband controller-based biofeedback system called *Relax*. And Atari, Inc., (before corporate reformation) exhibited a similar system, MindLink, at the Summer 1984 Consumer Electronics Show. Both are based on electromyographic impulses—slight electrical pulses from muscles in the forehead—which permit the user to control onscreen computer action without touching a keyboard, joystick, or other input device.

• **Laser disks:** More and more uses are being found for laser disks as computer peripherals. For now, most applications are commercial or governmental, things like employee training, says David S. Backer, director of videodisk research for Mirror Systems Inc., a firm that is developing uses for laser disks in the business market.

With the ability to put more than 50,000 live action images on one side of a disk, and the availability of inexpensive interfaces, the future looks bright for this peripheral. Digital Research, for example, markets a $49 interface which attaches a Commodore 64 to a laser disk player.

"I think you're going to begin to see large image data bases, or big slide-a-thons produced by various institutions—everything from museums like the Smithsonian on up to publishers—people who have some kind of interesting image file. That [area] has consumer potential," Backer predicts.

Laser disks will probably be a major force in interactive video over the next few years. More than 50,000 live-action images can be contained on each side.

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• **Laser Printers:** The price for a good laser printer has already dropped from about $20,000 down to the $3,500–$7,000 range, and the decreases will continue as this technology gets cheaper. Much like a photocopying machine, a laser printer creates an image on a rotating drum that has been electrically charged. A powdered plastic, also charged, sticks to the portion of the drum that has been neutrally electrified by the laser. Then, using heat, the powder is transferred onto paper.

The $3495 HP LaserJet Printer (Hewlett-Packard) prints eight pages a minute, including graphics, by using lower cost laser technology.

Inexpensive plastic drums and cheaper laser technology are making these printers more popular. Manufacturers like Hewlett-Packard and Canon have made rapid advances in this field, although there are still problems to be overcome. The laser printers don't print in color, can't process multiple-copy forms, and are still more expensive than dot-matrix and daisy wheel printers to operate.

• **LCD screens:** New technology is making color liquid crystal displays (LCD) possible in everything from television screens to personal computers. While monochrome LCD displays have been around for years, and are found on many appliances, color has been a problem because of the way an LCD receives and responds to electrical signals.

Now, however, using silicon thin-film transistors (TFTs), color is becoming available on small screens. Epson has marketed a television with a two-inch color flat screen LCD, and several other firms are working on new applications in larger formats.

• **Microfloppies:** The fight is on among several manufacturers to market smaller computer disks with larger storage capacities. Sony is promoting its 3½-inch microdisk (adopted by Apple for the Macintosh); Hitachi has a 3-inch disk; and Tabor markets a 3¼-inch version. No matter which format prevails, expect to trade in your 5¼-inch disks eventually. It's something of a race: Will compact discs or these 3-inch disks capture the market first?

The new disks come in hard plastic housings, and can already store almost a megabyte of data per disk side. That, too, will increase as the technology improves.

• **Musical keyboards/sound sampling devices:** Synthesized music is another area where prices have been driven low enough to make sophisticated musical tools available to home computerists. Waveform, Sight & Sound, Roland, Sequential Circuits, and Sweet Micro Systems all make keyboard products available for as low as $50 on up to around $500. That's quite a bargain when you consider that similar devices retailed for thousands of dollars each in the not too distant past.

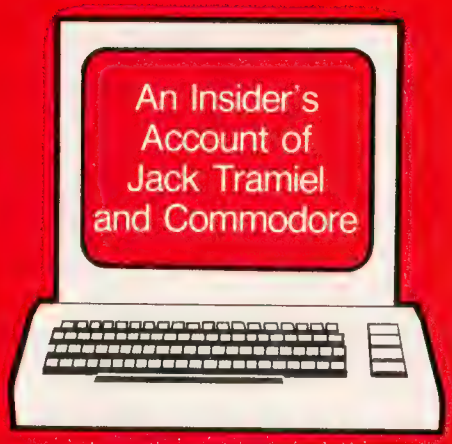
Another breakthrough has come in the area of audio sampling. CompuSonics, a Denver-based electronics firm, has introduced an audio system that allows users to make digital disc recordings at home—on a floppy disc. The company's machine, the DPS-1000, digitally records sounds as ones and zeros on the disc, resulting in the impressive fidelity of ordinary compact discs. The DPS-1000 can be plugged into any audio system. If attached to an IBM PC, the music can even be edited or synthesized.

Computerized musical devices are popping up everywhere, and some are truly astounding in their versatility and power. For example, Ensoniqs, a new company in Malvern, Pennsylvania, which includes engineers who invented the Commodore 64's SID sound chip, has announced an impressive digital sampling synthesizer, the Mirage, which sells for $1795. If you're interested in more details about this fast-growing area of home computing, see "Music In The Computer Age" in the January issue of COMPUTE!.

• **Invisible Modems:** These *mo*dulators-*demo*dulators, which transmit data between computers via telephone lines, are very popular peripherals among computerists. Advances are turning them from stand-alone units, however, to accessories built inside the computer itself.

A number of companies have introduced board modems that plug into a

THE HOME COMPUTER WARS



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computer's internal circuitry, and one firm, Code-A-Phone Corp. of Portland, Oregon, has developed a two-line telephone with a modem built inside. According to the market research firm International Resource Development, Inc. (IRD), digital telephones will build a significant market niche in the late 1980s, which could eventually mean the demise of the modem altogether.

• **Radio modems:** A device that can send software, text, articles, and photographs via an ordinary AM or FM radio to personal computers has been developed by The Microperipheral Corporation of Redmond, Washington. Called the Shuttle Communicator, it plugs into the receiver jack on a radio and the RS-232 port on the computer. It works essentially like the demodulator portion of a modem.

The company is negotiating with a national radio satellite network to syndicate a radio show which would offer computer news and free software, and hopes to have the system on-line near the end of February. Since a telephone is not involved in the process, the Communicator can download information at 4800 baud, much faster than most modems. At that speed, a 1K program could be downloaded in two seconds.

The Shuttle Communicator can download information from a radio station to any home computer, at speeds of up to 4800 baud.

The device is scheduled to retail for about $70, and will come with the necessary terminal software. Versions designed especially for the Commodore 64 and Atari computers are also planned.

• **Robots:** The prices range from $350 up to $5,000 or more for these programmable computer extensions. Their utility is still limited, but recent personal robots from such companies as RB Robot in Golden, Colorado; Androbot, Inc., of San Jose, California; and the Heath Company of Benton Harbor, Michigan, are making these super-peripherals both more practical and functional.

• **Vertical Recording:** Your present floppy disk stores information by rearranging magnetic particles which are aligned end to end, horizontally. But a significantly larger storage space is created on that same disk if the particles can be aligned vertically. Expect to see some vertical recording floppy systems, possibly with several megabytes per disk, in 1985, particularly from the Japanese company, Toshiba.

In general, growth in the computer peripherals market is predicted to increase almost 300 percent by 1994, to $17.6 billion, according to IRD. Total peripheral sales for the office and home computer markets in 1984 were $4.5 billion. IRD predicts that most of the sales by 1994 will be made to manufacturers, however, and not retailers, as computer firms move toward including peripherals with their basic systems.

"By and large, customers buy a single label computer system—keyboard, console, and disk drives—and don't care which supplier makes the various parts," states IRD. "There is little, if any, incentive for a customer to buy a different disk drive and display monitor when the original price of the computer already includes them."

The largest growth in the peripherals market will be in communications hardware, according to IRD analyst Maureen Fleming. By 1994, factory sales in that portion of the market will grow 1334 percent, from $230 million in 1984 to $3.3 billion, she says. The input device market, including voice recognition systems, mice, and optical scanners, should grow 424 percent, from $420 million to $2.2 billion.

While interest in modems and mice is expected to remain high over the next ten years, IRD is projecting that the printer market will have a somewhat slow growth rate of 82 percent during that same time span. Price wars among manufacturers will contribute to this lower growth rate. IRD figures show printer sales of $1.2 billion in 1984, and $2.2 billion by 1994.

Eventually, the very nature of peripherals themselves will probably change, as manufacturers increasingly make *intelligent* peripherals, equipped with their own microprocessor brains, much like many of today's cars, cash registers, and washer-dryers.

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Cardco's monitor tuner offers television for your monitor at the flip of a switch.

While the choice between monitors and television sets is usually an easy one, no peripheral for your Commodore 64 is likely to be trickier to choose than a printer. The many different companies, the various types available (dot matrix, daisy wheel, thermal, thermal transfer, ink jet, etc.), and the continuing price cuts by manufacturers make this an exciting but potentially frustrating decision for the 64 owner. We'll discuss the ins and outs of buying and using a printer in an upcoming issue, but for now a few warnings should help you in your search.

Compatibility is the watchword here. Ignore it and you may wind up taking home a printer which at best doesn't fully use the power of the 64 and at worst is almost worthless. The built-in graphics characters which are directly accessible from the 64 keyboard, for example, can't be reproduced by some printers, at least without the addition of a ROM chip or some other modification. Before you begin to look for a printer, decide on what your uses are likely to be. That will make the tradeoffs on price, performance, compatibility, and other factors much easier to assess.

If you want to print program listings, an inexpensive printer will suit your needs. For letters or business applications, you'll need a printer that handles standard paper (single sheets or formfeed) and offers correspondence-quality characters. And make sure the software you own will work with the printer you choose.

Commodore currently offers three dot-matrix printers for the 64, the MPS-801, the MPS-802 (an enhanced version of Commodore's 1526 printer), and the new MPS-803. "Someone who is doing more in the business or productivity end of applications normally will buy the MPS-802," says Dow. "We're seeing the MPS-803 being bought by individuals interested in the educational and recreational aspects of the product itself—more of an all-purpose printer because it does standard text printing, but also has the capability to do dot-addressable graphics."

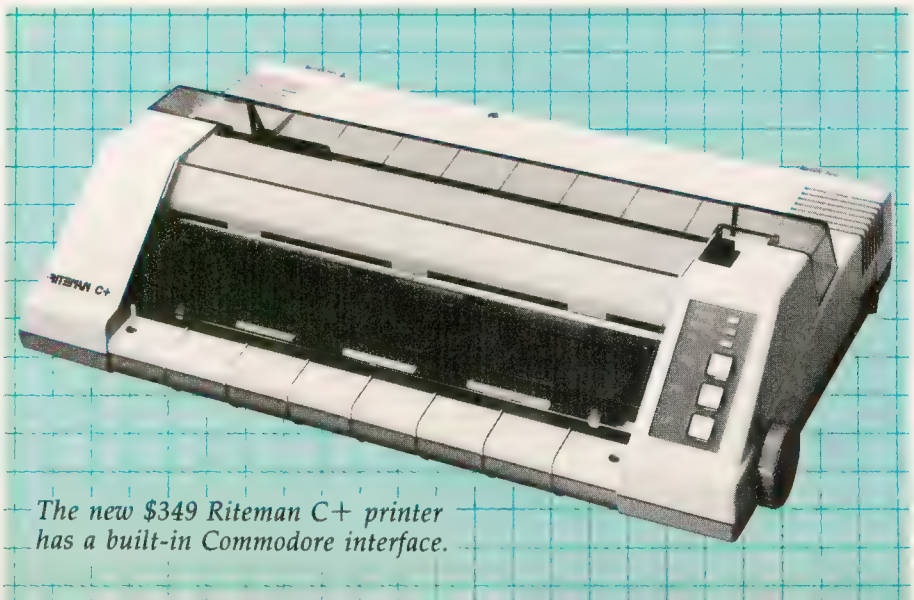
As the 64 became the clear leader among home computers in 1984, printer manufacturers raced to provide the best print quality at the lowest price for 64 owners. That is continuing, making your purchase of a printer a potentially formidable task. Companies such as Alphacom, Blue Chip Electronics, Cardco, C. Itoh, Epson, Ergo Systems, Leading Edge, Okidata, Star Micronics, and many others provide printers which you'll want to compare before deciding.

Joining the list are two new dot-matrix printers from Riteman: the R 64 and the Riteman C+. Both include a built-in Commodore interface and offer Commodore graphics characters.

The R 64 has both parallel and serial capacity, so it can be used with other computers as well as the 64. It prints at 120 cps and employs bit image graphics. It sells for $449. The Riteman C+, priced at $349, prints at 105 cps.

Perhaps the fastest growing area of home computing is telecommunications—the sending and receiving of data between computers.

"This is really becoming a very hot item, not just for Commodore, but for the industry in general," says Commodore's Dow. "And I think we're going to find more demand for



The new $349 Riteman C+ printer has a built-in Commodore interface.

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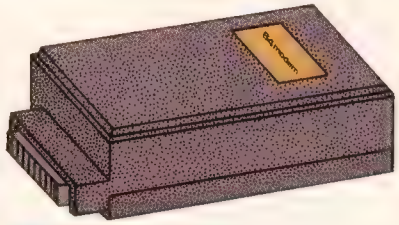

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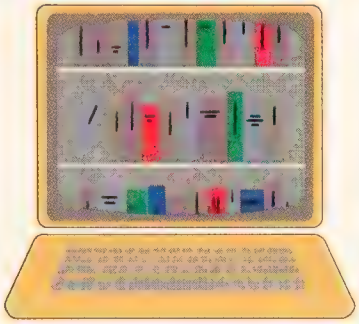

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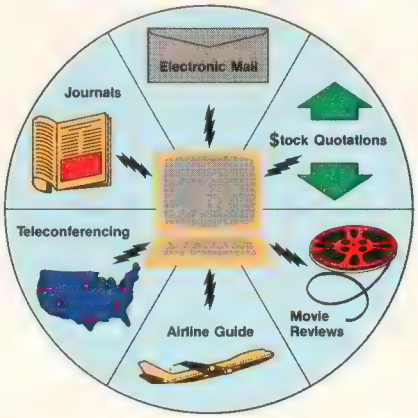

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modems as we find more and more people offering different types of services. Modem sales for us have been strong, and it's going to get stronger as time goes on."

The modem is simply a device which modulates digital data from your computer into analog sound transmissions carried by the telephone lines, and then demodulates those same type of analog signals when your 64 receives data from another computer via the phone. There are two types of modems. An *acoustic* modem has rubber cups into which your telephone's handset fits and sends signals acoustically through the telephone; a *direct-connect* modem plugs directly into the phone lines, as its name implies. Acoustic modems are older and less reliable, and are therefore being superseded by the newer direct-connect devices.

You should be aware that the 64's RS-232 (a Recommended Standard, hence RS) serial port—through which your modem will communicate—is not compatible with the industry-accepted RS-232 port. Make sure that the modem you buy is compatible with the 64, or you'll have to buy an adapter to make it work.

Commodore now offers three different modems, each of which connects directly into the 64's user port, but offers different capabilities. The 1600 VICModem (about $50–$70) and the 1650 AutoModem (about $79–$100) have been joined by the 1660 AudoModem (about $100). The latter two allow your computer to automatically redial numbers when necessary and to automatically answer incoming calls from other computers. In addition, the 1660 has a speaker built into it so that you can monitor the audio status of the modem. It works with the Plus/4 as well as the 64 and VIC-20, notes Dow.

In addition to the Commodore modems, there are a variety of 64-compatible modems that have become available from other manufacturers. Human Engineered Software (HES) manufactures two HESmodems, one priced at $74.95 and the other at $109.95. Anchor Automation now offers the $99 Westridge 64-20 modem, Taroco is selling the $99.95 Mitey Mo,

Commodore's new 1660 Automodem.

and other modems by Intec Corporation, MFJ Enterprises, Inc., and The Microperipheral Corp., are all compatible with your 64 without the need for an interface. (See "A Buyer's Guide To Modems" in the November 1984 GAZETTE for more detailed information.)

The expanding base of peripherals for the 64 includes a variety of input devices. As more and more people have been brought into the world of computing, an increasing percentage are unaccustomed to typing, and hence, keyboards. Children especially can find the array of 67 different keys on the Commodore 64 a daunting and frustrating means by which to learn about computers.

To combat this problem, a number of companies have come out with products aimed at easing a child's first exposure to computers. Simplified plastic keyboard overlays are now being used in many early learning programs, such as in CBS Software's Sesame Street series. Koala Technologies released the Muppet Learning Keys in 1984, a plug-in pad which features easy-to-use letters, numbers, colors, and other functions.

"Alternative input devices are becoming more and more important as time goes on in just about every segment of the marketplace, particularly the home," says Dow. "We're working on a variety of different forms of input devices."

At last year's Consumer Electronics Shows, for instance, Commodore displayed its Touch Screen, a plastic overlay which fits over the front of a monitor or television set. By touching the screen with your finger or a pointer you gain access to menus and other controls in a variety of programs. Although not yet released, the Touch Screen—in some form—is expected to be available soon,

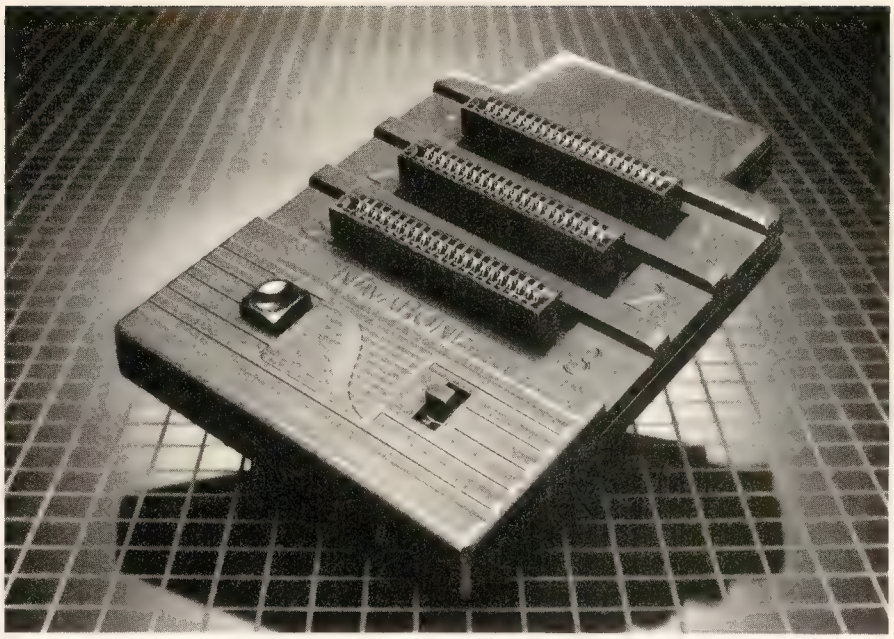
perhaps by the time you read this, notes Dow.

Even novice computer users are at least somewhat familiar with the joysticks, game paddles, touch tablets, keypads, and light pens which are the most familiar alternative input devices. Making decisions about these peripherals is usually not as difficult as is the case with printers, modems, or storage devices. But, as with all peripherals, what you plan to do with them can make the difference between wasted money and a genuinely useful addition to your 64 system.

Among the newer input devices are music keyboards which, with accompanying software, make use of the Commodore 64's Sound Interface Device (SID) chip. Companies like Passport, Sight & Sound, Tech Sketch, Sequential Circuits, Waveform, and others are selling a variety of these keyboards, with prices generally around $200 or less. (See "Commodore 64 Music For Non-Musicians" in the February GAZETTE.)

Over the past year or so, the *mouse*—a rolling desk-top device which controls the screen cursor and other onscreen functions—has become a very popular alternative input device for Apple, IBM, and some other computers. While Commodore reportedly has no plans to develop a mouse, a number of other companies are rumored to plan to produce them for the 64.

Beyond the five major peripheral categories mentioned here, there are still many more products which can make substantial differences in what you can do with your 64. Memory expansion devices, surge suppressors, reset switches, and cartridge slot expanders are among the peripherals you'll want to learn more about. Even an Apple II+ computer emulator for the 64 (from a Canadian company, Mimic Systems) should be available shortly. The complete package, called The Spartan, is expected to retail for just under $600 and allow your 64 to use standard Apple II+ hardware and software, according to a company official.



Navarone's $39.95 three-slot cartridge expander for the 64 lets you plug in up to three cartridges that are switch-selectable.

The U.S. home and office personal computer peripherals market will probably reach $26.4 billion in retail value by 1989, according to figures compiled by Future Computing, Inc., a respected computer market research firm. That's a $17.3 billion increase over the 1984 figure. The choices will continue to increase as manufacturers take advantage of the huge installed base of Commodore 64s.

With proper planning and a clear understanding of your needs, choosing peripherals can be another interesting aspect of computing rather than an expensive exercise in frustration.

While space limitations prohibit us from listing addresses for all of the companies mentioned in this article, the following should help you get started:

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Commodore Peripheral Ports

Ottis R. Cowper, Technical Editor

Commodore computers provide their users with a variety of methods for communicating with the outside world. The devices from which the computer receives input or to which it sends output (or both) are generically called peripherals, and the connectors where peripherals are attached to the computer are referred to as *ports*. Each of the several ports has distinctive characteristics that make it suitable for particular applications. For some, the computer's operating system—the ROM which controls the machine's functions—provides routines that handle much or all of the "dirty work" of communicating with devices attached to those ports. To use other ports, you must program all the necessary support routines yourself. That task can range from very easy (for example, reading a joystick) to quite complex (interfacing with a parallel printer through the user port, for example).

Here's a rundown of the features of all the ports:

The Serial Port

For most users, the serial port is the major data artery of the computer. As the connection point for disk drives and printers, it's the port through which most information exchanges take place. This is the one port that is the same on the VIC, 64, Plus/4, and 16. Well, almost the same—there are some signal timing differences. The VIC transfers data at a slightly faster rate than the others, which is one of the reasons the VIC is listed as incompatible with the 1526 printer, and why the original 1540 disk drive was only for the VIC. Obviously, this port is bidirectional—data can flow both in and out with equal ease.

The signal format used to exchange data over the six lines provided through this port is unique to Commodore. The format should not be confused with the more standard RS-232 serial communications format used by numerous peripherals; RS-232 communication is handled through the user port (see below). The serial port is essentially a stripped down version of the parallel IEEE-488 port used for most data communications in Commodore's earlier PET/CBM models. As the term *serial* implies, data can be transferred only one bit at a time (and in only one direction at a time, either in or out). Three of the other lines control the direction of data flow, and whether the signals on the data line are to be interpreted as data or as commands to the peripheral device. The computer's RESET line is also present at this port, which explains why the disk drive resets whenever the computer is turned on or off.

The operating system fully supports communications through this port. By addressing a peripheral attached to this port with a device number, and using OPEN, CLOSE, PRINT#, INPUT# and related routines provided by the operating system, you can avoid worrying with the details of controlling the individual signal lines. Any peripheral addressed with a device number between 4 and 31 (the highest device number allowed) is assumed by the computer to be connected to this port.

Commodore has established several standards for device numbers: Printers are usually device 4, although some can be changed to device 5, the 1520 Printer/Plotter is designed to be device 6, and device numbers 8 and above usually refer to disk drives. Device 8 is the default number for the disk drive, and almost all software assumes the disk drive will have this device number; device 9 is the most common choice for a second drive. Commodore 1541 drives allow you to select any device number via software, or numbers 8–11 via hardware.

The use of a unique signal format for communication with the disk drive is not unusual; almost all computer manufacturers use a proprietary disk interface compatible only with their own products. What is unusual is that this same nonstandard format is also used for communications with printers. Since so much software assumes that printers will be connected through the serial port (as device 4), most third-party interfaces for non-Commodore printers also attach to this port. These interfaces act as interpret-

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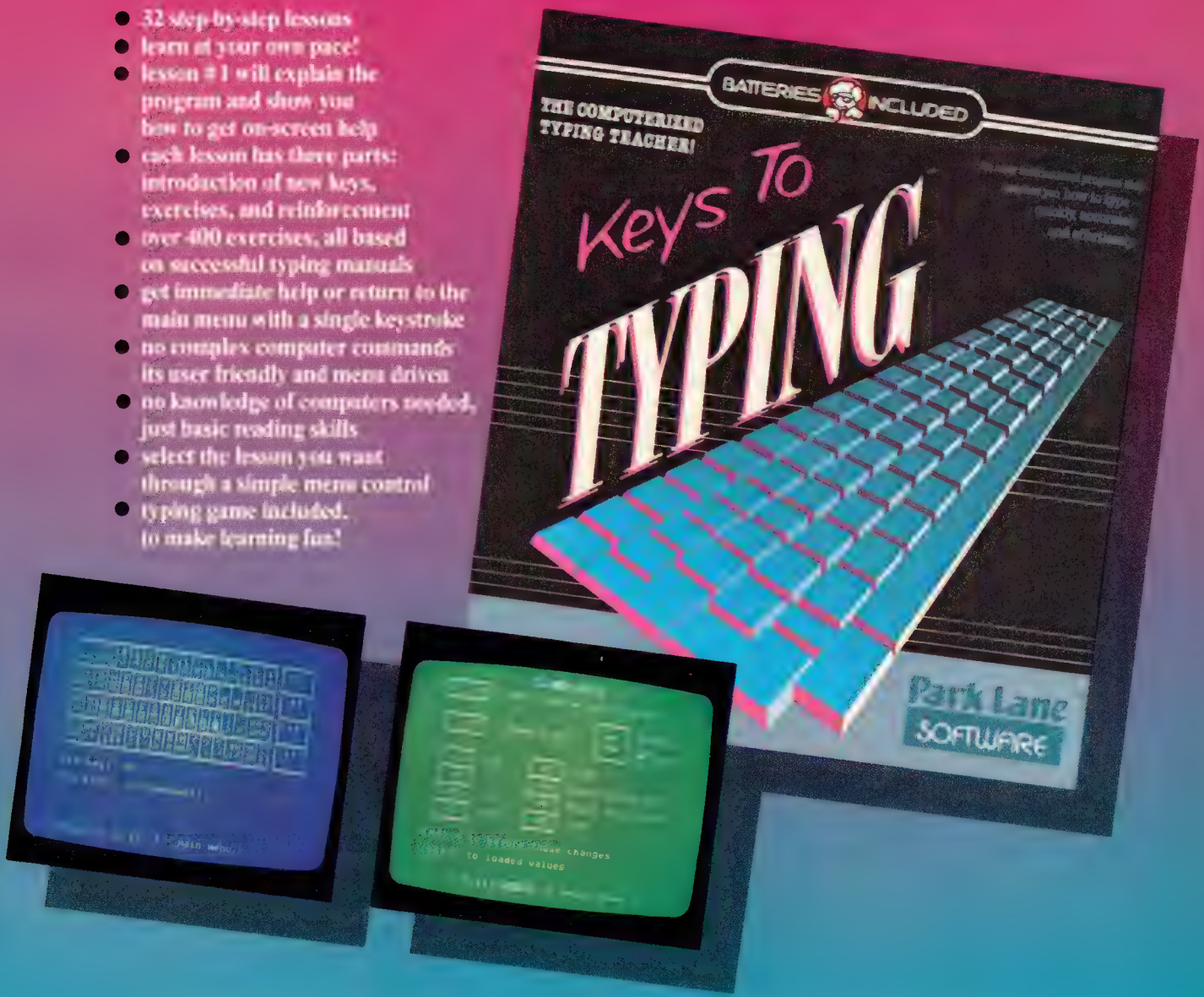

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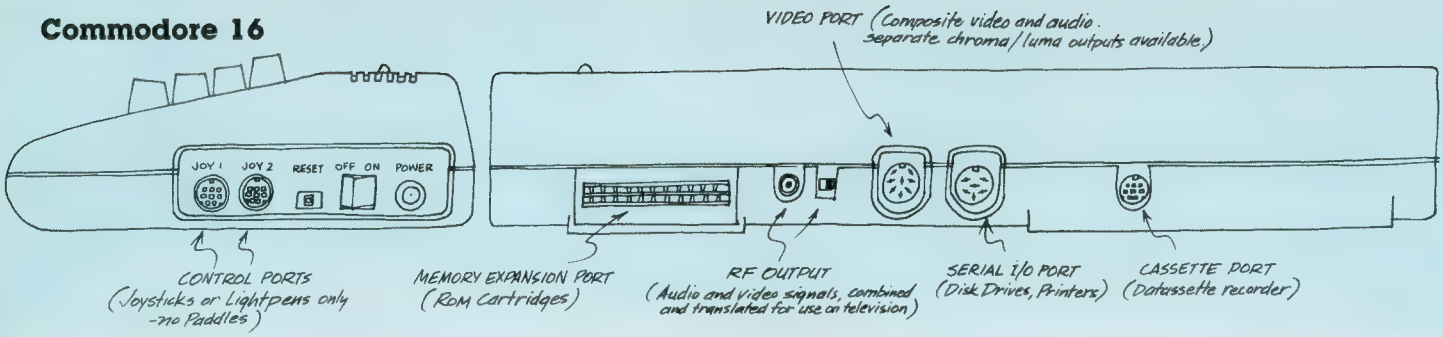
Commodore 16
VIDEO PORT (Composite video and audio. Separate chroma/luma outputs available.)
JOY 1
JOY 2
RESET
OFF ON
POWER
CONTROL PORTS (Joysticks or Lightpens only -no Paddles)
MEMORY EXPANSION PORT (ROM Cartridges)
RF OUTPUT (Audio and video signals, combined and translated for use on television)
SERIAL I/O PORT (Disk Drives, Printers)
CASSETTE PORT (Datassette recorder)

ers, reading the Commodore-format serial signal from the port and converting it to the more standard parallel (eight bits at a time) format used by most printers.

The Memory Expansion Port

This is often referred to as the cartridge port, since ROM cartridges are the peripherals most often attached through this connector. In the VIC, this is also the port through which RAM memory expanders are added. The lines available at this port include most of the address, data, and control lines of the microprocessor chip that is the heart of the computer. Thus, any peripheral which needs to be intimately tied to the workings of the computer—for example, ROM that must be addressed by the microprocessor—is connected through this port. The operating system does not support any devices through this port; in essence, anything attached here is no longer a peripheral, but part of the computer itself.

This port is present on the VIC, 64, Plus/4, and 16. Many of the same lines are available on corresponding pins of the expansion port connectors used in the VIC and 64, but the connectors themselves are different sizes, so cartridges designed for the 64 cannot be used on the VIC, and vice versa. The Plus/4 and 16 have identical 50-pin connectors for this port (as opposed to the 44-pin connectors used in the VIC and 64), so presumably there will be some compatibility of cartridges for these models, although no VIC or 64 cartridges or memory port peripherals can be used.

Examples of other types of devices which attach through this port are the CP/M cartridge for the 64, which contains a second microprocessor that takes complete control of the 64's RAM and input/output chips, and the Magic Voice speech module, which is attached through this port because it contains additional ROM to allow the computer to support voice output.

The User Port

This port (sometimes called the RS-232 or modem port) was designed with the experimenter in mind. Just as the memory expansion port gives you access to a number of the microprocessor's control lines, this port gives you access to many of the control lines of one of the interface adapter chips (VIAs for the VIC or CIAs for the 64). Using these lines, a wide variety of peripherals could be connected, since both serial and eight-bit parallel communications are available.

Unfortunately, most of this flexibility goes unused since it isn't supported by the operating system. Most home computer users today are more interested in software than in tinkering with hardware projects, so this port is most frequently used for its one function supported by the operating system: RS-232 serial communications.

RS-232 is the name of the most common serial communications standard. If you use the operating system to address device 2, data directed to that device will be transferred through the user port in an approximation of RS-232 format. Actually, the signal format is true RS-232, but the voltage levels are different from those prescribed. The standard calls for voltage levels of −12 to +12 volts, and the user port only provides levels of 0 to +5 volts. Adapters are available—from Commodore and other sources—to convert the signal voltage to the proper levels. These adapters are not necessary if you're going to use Commodore's modems, but are required to use any standard RS-232 equipment.

The 24 pins of this port have a similar configuration on both the VIC and 64, so many devices designed to interface to this port can be used on either computer, although the software to run the devices will generally be different. The VICmodem and Automodem, for example, work with either model. The Plus/4 appears to have the same 24-pin connector, but the computer casing around the connector is smaller, so neither the VICmodem nor Automodem can be plugged into the Plus/4. (Commodore's new 1660 modem works with the VIC, 64, and Plus/4.) The Commodore 16 has no user port, so it is as yet unclear if or how a modem may be used with that computer.

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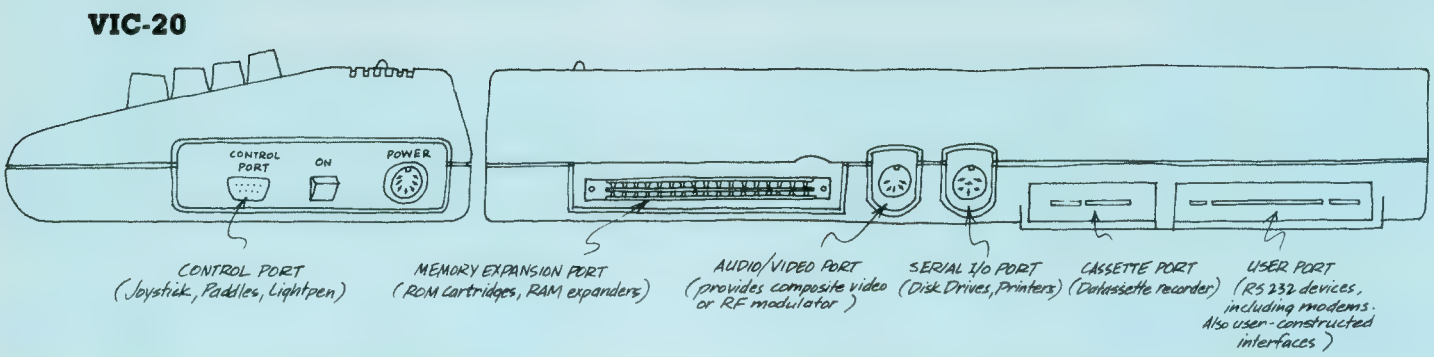

VIC-20
CONTROL PORT
ON
POWER
CONTROL PORT (Joystick, Paddles, Lightpen)
MEMORY EXPANSION PORT (ROM cartridges, RAM expanders)
AUDIO/VIDEO PORT (provides composite video or RF modulator)
SERIAL I/O PORT (Disk Drives, Printers)
CASSETTE PORT (Datassette recorder)
USER PORT (RS 232 devices, including modems. Also user-constructed interfaces)

Since eight-bit parallel data communications are available through this port, it might seem surprising that it's not commonly used for interfacing with printers. After all, it would appear on the surface to be simpler to write a machine language program to simulate the commonly used Centronics parallel format through this port, than to go to all the trouble of designing the hardware interface to convert the data from the serial port to the proper parallel format.

The reason this isn't often done is that almost all Commodore software expects the printer to be device 4 on the serial port, and in the long run it proves easier to seek a hardware solution to allow you to use the built-in operating system routines as provided in ROM. That way, you don't have to worry about having to load your printer handler routine into memory before you can use it, finding a safe place in RAM to store the handler routine, etc.

For more information on interfacing through the user port, see the article "Using the User Port" in *COMPUTE!'s First Book of Commodore 64.* VIC users might also be interested in two articles which show how to use the user port to provide a second joystick port: "Fighter Aces—Add A Second Joystick" (*COMPUTE!'s Second Book of VIC*) and "Tankmania: Adding A Second Joystick To The VIC" (COMPUTE!'s GAZETTE, April 1984).

The Control Ports

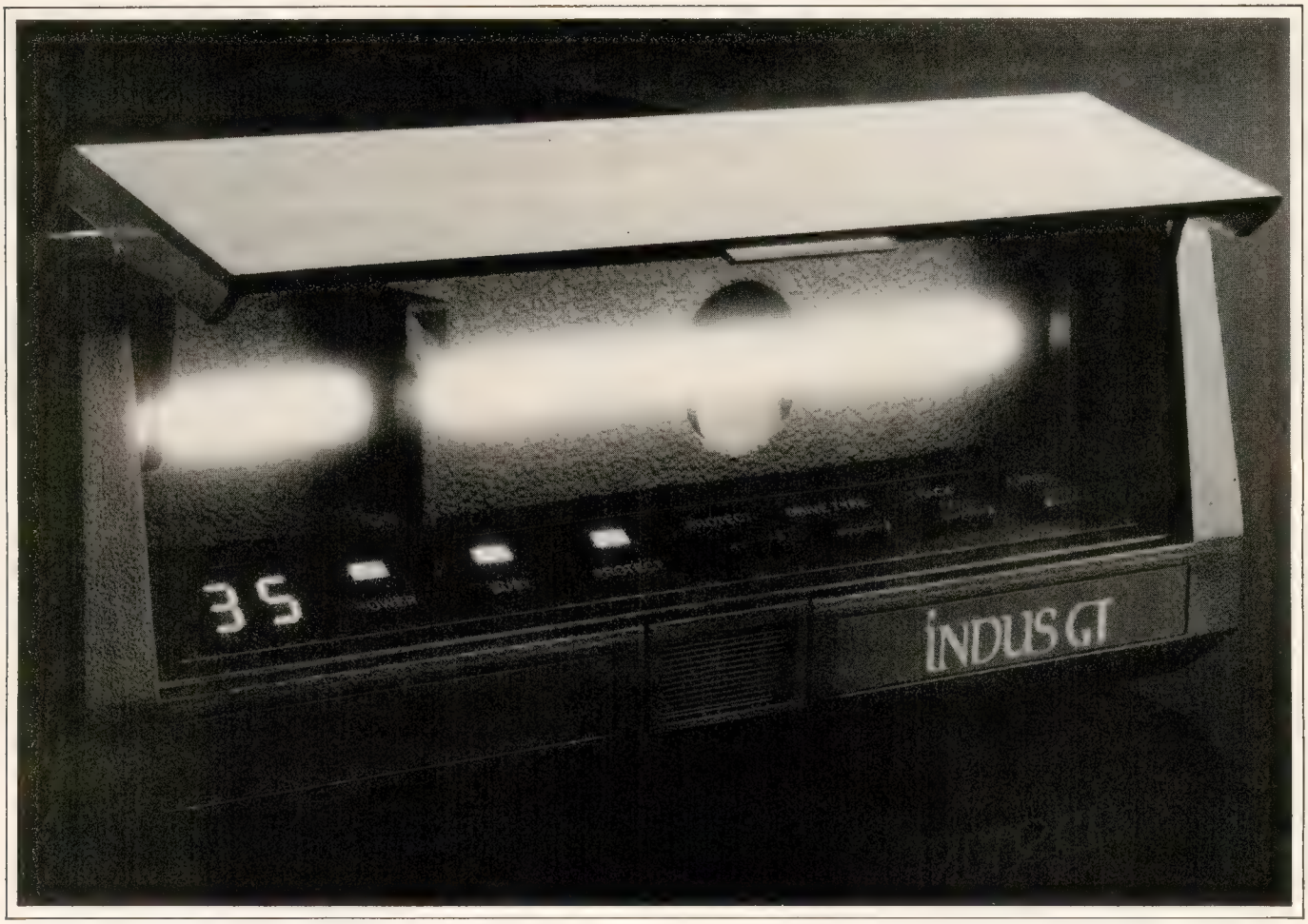
These ports (or port, in the case of the VIC, which has only one) are usually referred to as the joystick ports, since they are most commonly used for joysticks. In fact, on the Plus/4 and 16, these ports are labeled JOY1 and JOY2. The operating system ROM does not support any devices through these ports, so BASIC must communicate using PEEKs and POKEs.

In addition to joysticks, which are simple devices consisting of five switches—one for each of the four principal directions, plus one for the fire button—the ports can be used to read other devices that behave like joysticks, such as trackballs. Although the computer normally uses the five joystick lines strictly for input, it's possible to program them for output as well. We've never seen any peripherals for Commodore computers that attempt to output through this port, but there are printer interfaces for the Atari which use Atari's nearly identical joystick port. (Atari and Coleco joysticks are functionally identical to Commodore joysticks for the VIC and 64, and can be used interchangeably.)

A warning to those contemplating the purchase of a Plus/4 or Commodore 16: On those computers Commodore has abandoned the widely used DB-9 joystick connector in favor of a nonstandard connector, so existing joysticks cannot be used. Apparently, this was done to reduce radio frequency (RF) interference. The joystick mechanism is exactly the same, it's just the plug on the end of the cable that's been changed. And the new plug isn't one you'll be able to find easily, so—until someone comes out with an adapter plug—you'll be limited to buying only Commodore's joysticks. On the other hand, the improved BASIC in the Plus/4 and 16 includes a JOY function to read the joysticks, so the complicated PEEKs required to read joysticks on the VIC and 64 can be avoided.

In addition to the joystick, this port in the VIC and 64 can be used to read paddle controllers. (The Plus/4 and 16 have no circuitry for reading paddles.) Paddle controllers, which always come in pairs, are actually just variable resistors which provide variable voltage levels to two lines on the port. Circuitry within the computers (in the VIC chip in the VIC-20, and in the SID chip in the 64) calculates a digital value corresponding to the voltage level. The value ranges from 0 to 255 as the voltage on the lines changes from 0 to 5 volts. Other devices which operate like paddles—providing a varying voltage input—can also be read through this port; graphics tablets are a good example.

Each paddle usually also has a button, but instead of being read like the joystick buttons, the paddle buttons are connected to the lines for two of the joystick directional switches.



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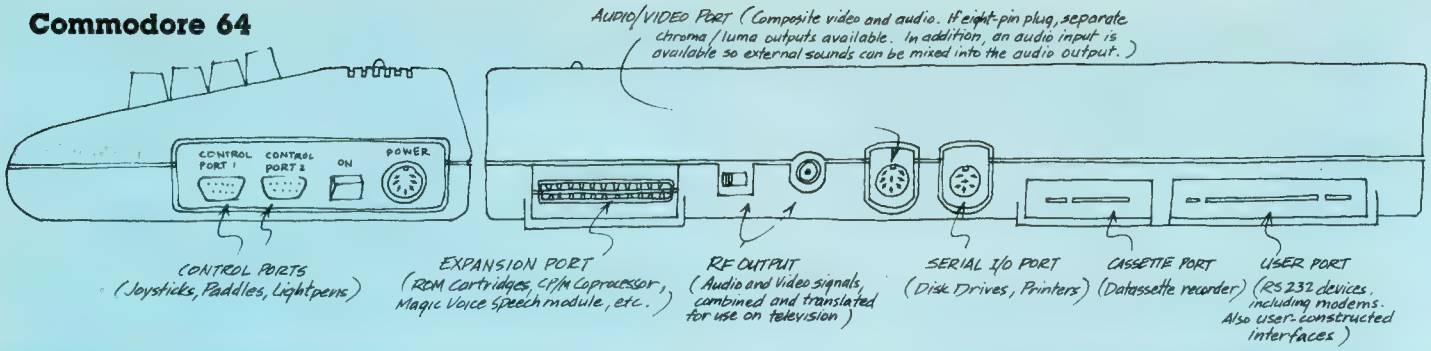

Commodore 64
AUDIO/VIDEO PORT (Composite video and audio. If eight-pin plug, separate chroma/luma outputs available. In addition, an audio input is available so external sounds can be mixed into the audio output.)
CONTROL PORT 1
CONTROL PORT 2
ON
POWER
CONTROL PORTS (Joysticks, Paddles, Lightpens)
EXPANSION PORT (ROM Cartridges, CP/M Coprocessor, Magic Voice Speech module, etc.)
RF OUTPUT (Audio and Video signals, combined and translated for use on television)
SERIAL I/O PORT (Disk Drives, Printers)
CASSETTE PORT (Datassette recorder)
USER PORT (RS232 devices, including modems. Also user-constructed interfaces)

One paddle button corresponds to the joystick's right directional line, and the other to the line for reading joystick left. By convention, the paddle that uses the right directional line for its button is called the right paddle, and the one that uses the joystick-left line is the left paddle.

Unlike Atari joysticks, Atari paddles are not completely interchangeable with those made by Commodore. While Atari paddles can be used with the VIC and 64, they have a higher resistance and thus are less accurate for Commodore systems. (A half turn on Atari paddles corresponds roughly to a full turn on Commodore paddles.)

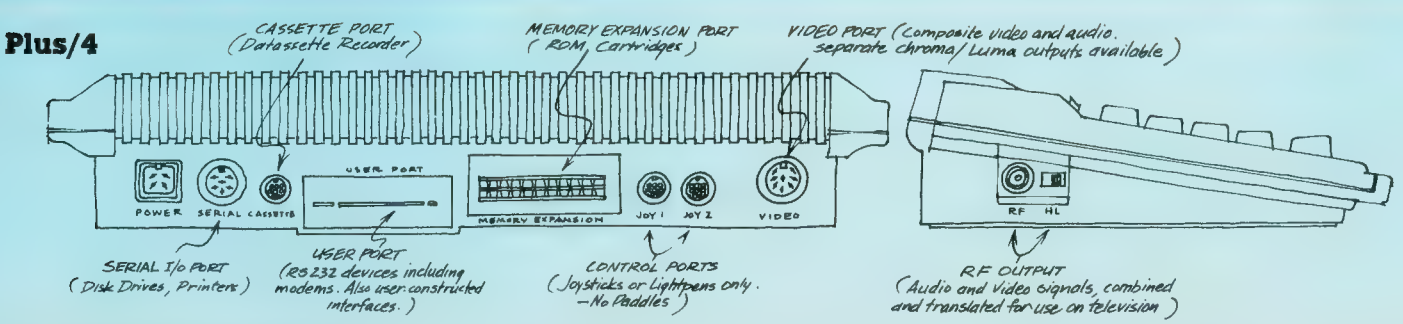
One additional type of peripheral—the light pen—can also be connected to this port. The pen contains a phototransistor that switches when it detects the electron beam of the video display sweeping past. A line is connected from the phototransistor through the port to the chip that generates the video signal (the VIC chip in the VIC, the VIC-II chip in the 64, and the TED chip in the Plus/4 and 16).

When the video chip receives the signal from the pen, it latches (stores) the current position of the raster (electron beam) in a set of registers (memory locations within the chip). The stored value can then be read, and the position where the pen is touching the screen can be calculated. (As with joysticks, Plus/4 and 16 owners will have to wait until someone manufactures a light pen with the proper plug to fit the unique socket used for this port by those computers.)

The Audio/Video Port

This connector is not really a port, since data cannot be transferred through it. Instead, it provides a connection point to the computer's video and audio signals. With the exception of an audio input line on the 64, all lines at this port are outputs only. Like the serial port, this port is compatible on the VIC, 64, Plus/4, and 16, but compatible doesn't mean identical. When attaching the computer to a video monitor, you need a cable that brings out two signals which are available at the same pins on all four models, a composite video signal and an audio signal. Corresponding video and audio inputs are found on most black and white or color monitors. The Commodore 1701/1702 color monitor also provides for the input of a luminance signal via the rear connections. Separating the luminance provides increased contrast, and drastically reduces color smearing.

Television users can attach a thin wire between the composite and luminance signals on the video port to improve television contrast, but some TVs can't take the extra luminance and produce a distorted screen. The more recent 64s use an eight-pin jack rather than the five pins used on the VIC and 64, but a five-pin monitor plug will still work. The eight-pin 64s have a purer color signal available for use with the rear connections of the 1701/1702, so you may want to use an eight-pin cable. The 64's audio input line attaches directly to the audio input on the SID chip. Be careful to feed in only low-level (unamplified) sound sources. There's no way to process the



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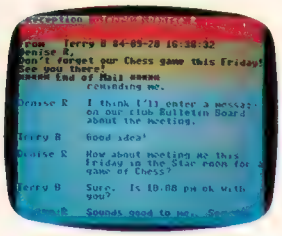

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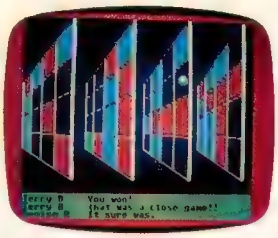

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sound, but it can be mixed with the sound of the SID chip, and the SID chip's filters can be used as a programmable equalizer for the sound coming in.

The Cassette Port

This port is designed for one particular peripheral, the Commodore Datassette recorder. There are now two models of the Datassette, the 1530 (or equivalent C2N) for use with the VIC and 64, and the 1531, for use with the Plus/4 and 16. As with joysticks, the only difference between the two is the plug on the end of the connecting cable. Commodore has used a new and incompatible type of connector for this port on its new models.

Three of the six lines from this port are used for writing a signal to the tape, reading a signal from the tape, and testing whether a button is pushed. Note that since there is only one line (labeled Cassette Sense) to test the buttons, it's only possible to check whether *any* buttons are pressed, not which particular button or buttons are pressed. Thus, if you're supposed to press PLAY and RECORD and accidentally press only PLAY, the computer won't be able to detect the mistake. Other lines supply power to the tape motor (9 volts) and for the electronics in the Datassette (5 volts). Some other peripherals—for example, several brands of printer interfaces—also make use of the 5 volt power source available here.

Communication through this port is fully supported by the operating system, with the Datassette being designated as device 1. Device 1 is the default storage device; unless you specify otherwise, all your SAVEs and LOADs will be directed to the Datassette. In addition to SAVE, VERIFY, and LOAD, the OPEN, CLOSE, PRINT#, and INPUT# statements provide all the features necessary for storing and retrieving data on tape, so programmers rarely need to worry about the intimate details of interfacing to this port, such as what sort of magnetic pattern is actually used to represent a byte of data on tape. Nevertheless, it's possible to program several of the individual lines of this port to achieve special effects; for an example, refer to the "TurboTape" articles in the January and February issues of COMPUTE!, the GAZETTE's sister magazine.

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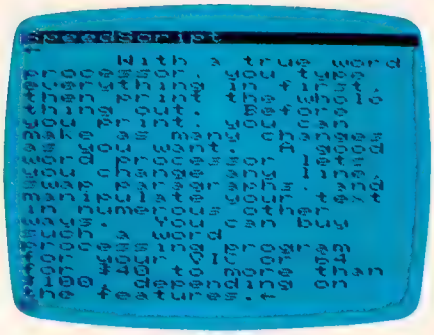
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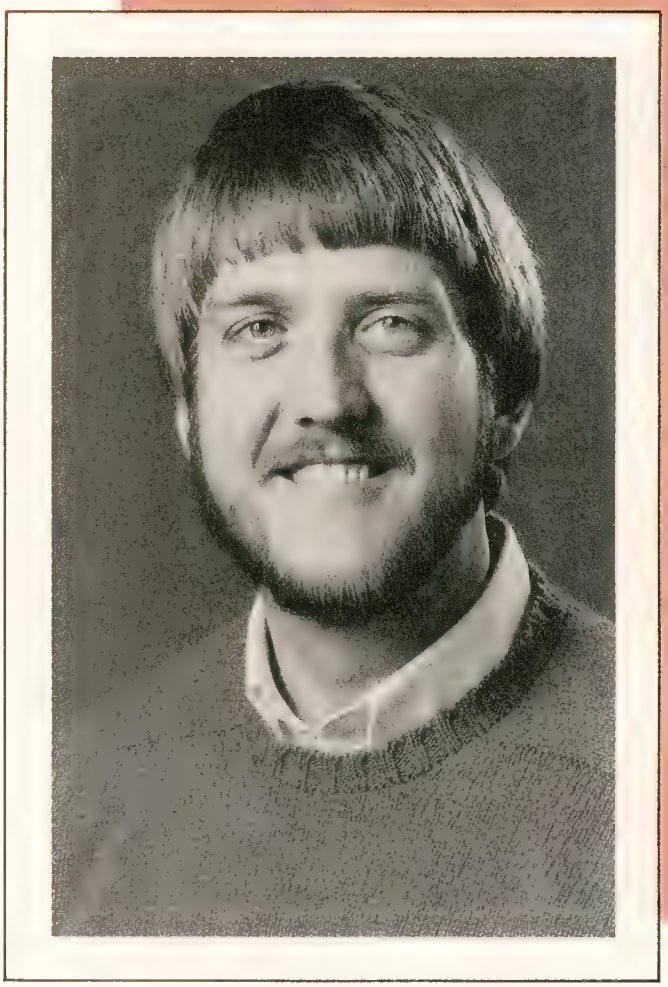
David Crane
The Designer Behind *Ghostbusters*

Kathy Yakal, Feature Writer

Who ya gonna call? GHOSTBUSTERS! You'd be hard-pressed to find someone who can't hum that tune. *Ghostbusters* was one of the top-grossing movies in 1984. Now there's a computer game based on the box office hit, designed by David Crane, one of the co-founders of Activision.



David Crane

How could the movie *Ghostbusters* have been anything but a smash hit? It had Bill Murray. It had a great theme song. It gave us heroes to cheer for. Its villains were not really very scary—one of the most ominous bad guys was a giant marshmallow man. And from the first ghost to the final fall of Zuul, its special effects were superb.

David Crane went to see *Ghostbusters* before it became *the* movie to see in the summer of '84. "I think I may have enjoyed it a lot more than some people because it was sprung on me," he says.

Crane, a program designer for and co-founder of Activision, was approached a few days later about doing a computer game based on *Ghostbusters*. Though he had really enjoyed the movie, he hesitated. "To do justice to any game takes no less than 500 hours of my time, and I was getting married in six weeks. So I had to think long and hard."

One of the reasons he finally agreed to do it was that he had already started writing the

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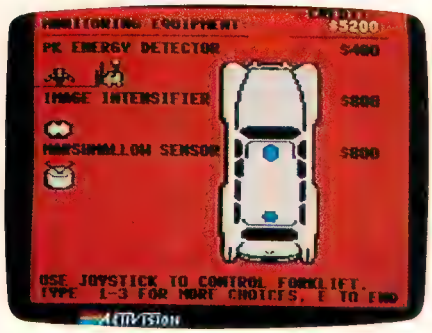

Outfitting the Ghostmobile.

game without realizing it. For the previous few months, he had been working on a game for the Commodore 64 that was going nowhere. It had something to do with equipping a car and driving it through city streets, but there was no story there. "It was a game concept in search of a theme," says Crane.

"It's an amazing coincidence that what I was doing followed the script of the movie. I was able to put the theme and game together in such a way that I could have what's really an original game concept that embodies the spirit of the movie."

David Crane grew up in Nappanee, Indiana, a very small town with a population of about 500 and not very much going on. In high school, he got involved with a local career center that helped provide students with vocational training. "Though their intention was to teach you a skill that would help you go out and get a job—programming for a bank or something—some of us just used it to learn how to program computers in three languages and then went on to college."

Crane attended the De Vry Institute of Technology in Phoenix, Arizona, to learn electronic engineering. He had already studied Fortran, RPG, and COBOL, so he decided not to take the fourth programming class, BASIC. "Computer skills are the kind of thing you learn once and you don't use," he says. "Once you know a couple of computer languages, all you need is about a one-page summary of what the instructions do."

Who ya gonna call?

After graduation, Crane felt he had a firm enough grasp of computer technology to get a good job in that field. "But instead of doing that, I asked myself, 'What *don't* I know enough about to work in that field?' So I took a job in that field to round out my expertise and experience."

So he started working at National Semiconductor in 1975, in a department that made chips for non-computer electronics. It was his job to introduce computers to the engineering department, and he built his own computer to do it.

"After two years at National, I felt I could do just about anything in electronics," says Crane. "So what did I do? I took a job as a game designer at Atari, where I didn't use any of my engineering skills whatsoever."

Crane had always been an avid game player, participating in national foosball tournaments in college and playing any mechanical games he could find—pinball, *Pong* when it came along, and later, videogames. As a student, he built a tic-tac-toe-playing computer using only discrete electronic components ("That was in the era before microprocessors.").

He had written programs to play games and built machines to play games through the years, so he knew game design was fun for him. "But it was questionable whether I wanted to do computer programming for a living. I had been doing engineering for the past two years, so it was kind of a leap off the deep end for me to be paid for doing computer programming."

Ghostbusters!

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After a couple years at Atari, Crane was ready to move again, as were some of his coworkers. "There was a group of us that knew we were good, so we set out to start a company," he says.

While consulting an attorney to find out whether they should be a corporation or a partnership, they were referred to Jim Levy, a friend of the attorney. "It was a very serendipitous meeting," says Crane. Levy became one of the original founders of Activision, where he remains president today.

Activision's corporate charter describes the company as a provider of entertainment software for computers—rather forward looking for 1979, when games were still being played on video cassette systems. Their first products were four videogames for the Atari VCS: *Dragster, Fishing Derby, Boxing,* and *Checkers.*

"We've always known that we would start with the simple form of home computer, which is the VCS, and move into the more elaborate home computers that we knew would exist about this time," says Crane.

Crane is rather an anomaly in today's software development industry, where many designers have gone independent and contract their programs to publishers. Activision is his employer, and he and the other game designers go in every day and work in an office.

But that's always been his plan. "We were all game designers and we knew that that was and is our strength. I would never have attempted nor desired to run the company."

Not such a bad-looking bad guy: the marshmallow man.

Which is not to say he punches a time clock. Though in his "off" times, he might put in 30 hours a week, he's working 80 when it's busy. "You basically work when you've got the inspiration.

"When you're programming, you have to maintain more than a thousand details in your mind at one time to make sure that when you're finally done, it all comes out the way you envisioned it in the beginning. It's pretty intense. I work until I can't see straight, which is quite often early in the afternoon."

The movie *Ghostbusters* was a hit because " . . . it was well done, funny, and treats a subject that may not be funny with humor. They managed to carry it off with only a few people being scared," says Crane. "It had that rousing sense of adventure of driving through the streets with a police escort and saving the world—all the things you might want to do as a hero. I tried to put those things into the game."

And many of the important images from the movie are, indeed, in Crane's computer version. At the game's start, you must buy a car and outfit it with equipment like ghost vacuums (to suck up ghosts), ghost bait (to lure the intrepid marshmallow man), and traps (to store the ghosts after you've nabbed them).

Once equipped, you're shown a map of the city; buildings flashing red are ghost-ridden. You drive to those buildings, aim your weapons at the elusive ghost, and fire (without crossing the streams). If you're successful, the little ghostbusters jump up and down and shout "Ghostbusters!" If you miss, you get "slimed." The game ends when you get past the marshmallow man and into Zuul. (Ray Parker Jr.'s funky theme song plays at the opening and throughout the game.)

It may be that David Crane will be on top of one of the next new technologies or game genres to come along, possibly before many people even envision it. "Back in the days when people were still playing space games, I had tired of space games," he says. "I've been successful because of that. I end up producing what people are ready for about the time they're ready for it.

"I will design computer games for as long as I find it fun, and I still foresee a few more."

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28K Software Buffer	YES	NO
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Heat Seeker

Jeff Wolverton

Your jet climbs upward to avoid the missile, then dives for the ground. But it's still on your tail. You can't shake a heat seeker. A fast action game originally written in BASIC for the unexpanded VIC, we've added a machine language 64 version. Joystick required.

Heat seeking missiles are dangerous. They sense the heat from your jet engine and home in on you. They'll catch you, too—they're faster than a jet.

Your assignment: Eliminate the heat seeker base. It's easy enough to strafe the missiles on the ground, but if any are launched, you'll have to take evasive action. And air mines can get in your way.

Piloting The Jet

Use the joystick to control the movement of the plane. The controls may seem to be a little confusing at first. You pull back to loop upwards (counterclockwise) and push forward to loop down (clockwise), like a real airplane. The jet moves at a constant velocity—you can't speed up or slow down. Press the fire button to launch a missile at the heat seekers on the ground.

In the VIC version, you can also fire at the heat seeker pursuing you (see below for details about the 64 version). Also, you must avoid running into the air mines (VIC version only), which block your way. You can shoot the mines to score a few points. It's also possible to accidentally shoot yourself.

If you manage to eliminate all the heat seekers, you get to start all over again, with a new group of heat seekers. You have eight jets to work with—the number remaining is displayed on the screen, next to the score. To pause the game, press SHIFT/LOCK.

Notes On The 64 Version

In translating from the VIC to the 64, several modifications were made. The jets and missiles are now sprites (rather than redefined characters), so the movement is smoother. And the 64 version is written entirely in machine language, so it plays much faster.

You can fire at heat seekers on the ground. But it does no good to fire at a moving heat seeker. They're equipped with an Improved Electronic Evasion (IEE) circuit which makes them impossible to hit. The only way to get rid of a seeker is to make it crash into the ground. When you're being pursued, dive for the ground and pull up at the last second. Seekers are faster, but they can't turn as quickly.

Unlike the VIC version, the plane can't shoot itself. And there are no air mines. If your jet is destroyed, all missiles reappear. In VIC Heat Seeker, no bases are rebuilt until all of them have been destroyed.

A two-player mode has been added. It's not competitive: The players take turns flying the plane, trying for the highest possible score. The game reads both joystick ports, so if you're using two joysticks, the inactive player should put down the joystick to avoid interfering.

There are three levels of difficulty: Novice, Intermediate, and Expert. The higher levels have faster action and tighter curves. A flight-time bonus of ten points is awarded every few seconds, just for staying in the air.

Special Instructions

VIC Heat Seeker is written in BASIC for an unexpanded VIC. Remove or disable memory expansion, type it in, save to disk or tape, and type RUN.

The 64 version is written in machine language and loads into the area usually used by

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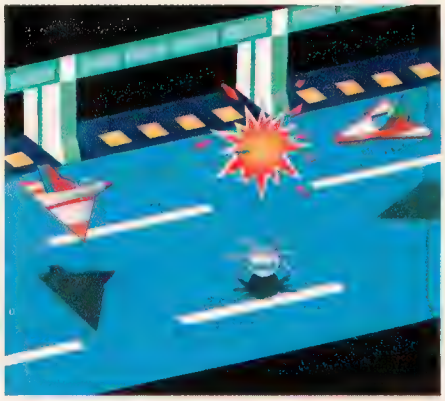

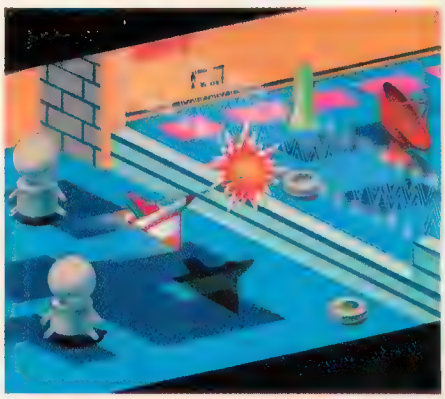

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INTRODUCING FROGGER II THREEEDEEP AND SUPER ZAXXON.

Unlaunched missiles are sitting ducks, but become deadly once they're airborne (VIC version).

A heat seeker homes in on the jet, which has nearly cleared the screen (64 version).

BASIC programs. You'll need the MLX machine language entry program to enter 64 Heat Seeker, but first you'll have to move the start of BASIC up. Follow these directions:

1. If you don't have a copy of MLX for the 64, type it in and save to tape or disk (MLX appears in alternate months of the Gazette).

2. Turn the computer off and then on and type: **POKE642,32:SYS58260**. If you omit this POKE and SYS, you'll get an error in line 550 of MLX.

3. Load MLX and type RUN.

4. Answer the prompts:
Starting Address: 2049
Ending Address: 6470

5. When you've finished typing in Heat Seeker—and have saved a copy to tape or disk—turn off the computer and turn it back on.

6. The enabling SYS is built into the program. After loading 64 Heat Seeker, type RUN.

See listings on page 131.

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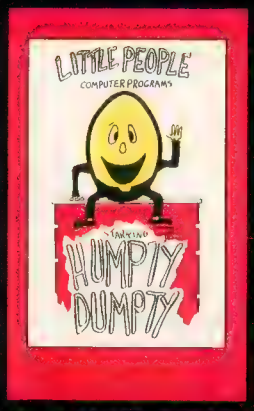

Humpty Dumpty
Alphabet program by Dave Paulsen
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Number program by Joe Sams and Scott Barker
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Teaches money values — one dollar to one hundred dollars — using an ice cream machine. Encourages money saving.

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by Doug Knapp
Learn to recognize geometric shapes and how to spell their names.

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by Tom Wanne
Teaches identification and meanings of traffic signs and signals. Increases safety awareness.

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DEALER INQUIRIES INVITED

The goats are in hot pursuit. They're almost invincible as they relentlessly munch their way through the underground world you call home. Your only defense is to strategically lure them under a falling boulder. A fast-action game originally written for the VIC, we've added a version for the 64.

The object of "Digger" is to avoid three billy goats who are pursuing you through underground terrain. Press f1 to start the game. You can make the goats vanish by digging the soil from under any of three rocks. Once the rocks are free, they fall until they hit soil again, removing any goats that may be in their way.

The goats can also be immobilized momentarily by inflating them with your trusty air pump. The air hose is fired by pressing the fire button while running toward the target. Once the hose has engaged a goat, press f7 to inflate the goat. You cannot disengage until the goat is completely inflated. Meanwhile, the other goats continue to hunt you down.

The action of the fire button may take some getting used to. You must be moving and pressing the fire button at the same time to activate the hose.

When all three goats are removed, a second screen is started by pressing the space bar, and play continues with increasing scores. For each screen completed, you are awarded a flower which appears at the top of the screen. If a goat touches you in any round, the score returns to zero and all flowers are removed.

The VIC version of Digger must be typed in using VIC MLX (published periodically in the GAZETTE) on a VIC with at least 8K expansion memory. Before doing so, however, turn your computer off, then back on and type the

64 Version Notes

Gregg Peele, Assistant Programming Supervisor

In the 64 version, Digger is a happy elf who survives in a subterranean world by eating her surroundings. Only one problem faces Digger. She is constantly pestered by three trolls who dig around her. Digger's only defense is to lure the trolls to dislodge underground rocks. These rocks may then fall on the unsuspecting troll causing it to vanish temporarily. Digger must be very careful not to touch any of the trolls or the rocks since all vanished trolls will immediately return.

As Digger's controller, you get 10 points for each vanished troll and 100 points for clearing the screen of all trolls. Using a joystick in port 2, you may move vertically or horizontally. Digger keeps moving until you stop her by moving the joystick diagonally. You can pause the game by pressing the SHIFT LOCK key. Note that the 64 version does *not* have the air pump feature.

Digger uses hi-res graphics and sprites to represent the underground world and the characters which "eat" their way around within it. A raster interrupt separates this world from the text area used for the score. As the game progresses within a particular screen, fewer characters must "eat" their background. Thus, the game becomes substantially faster.

Digger must be typed in using 64 MLX (published periodically in the GAZETTE). Enter 49152 and 52187 for the starting and ending addresses, respectively. After typing in the program and saving to disk or tape, you can run Digger by typing SYS49152.

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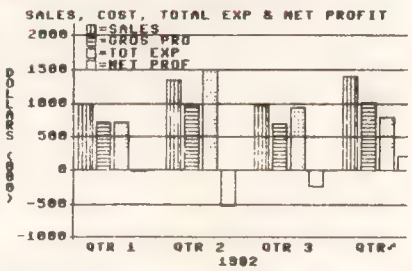

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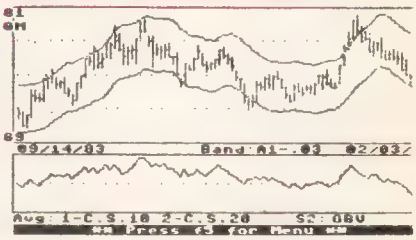

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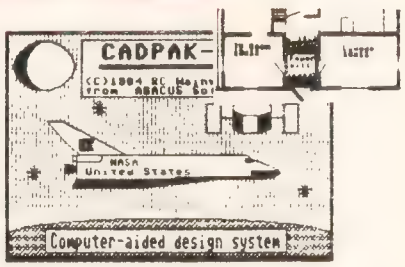

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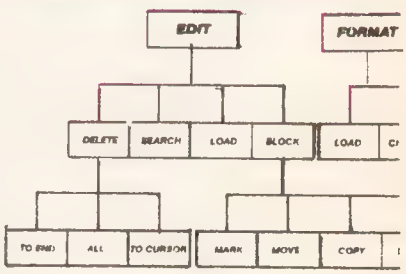

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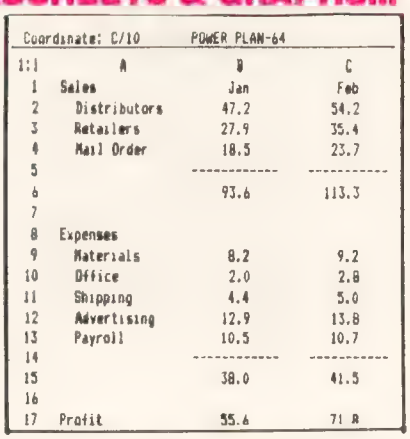

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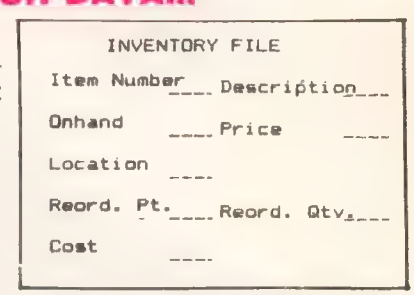

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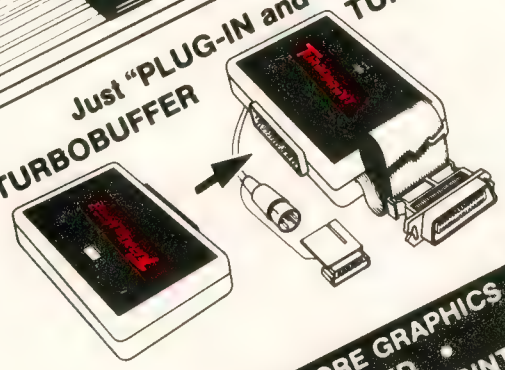

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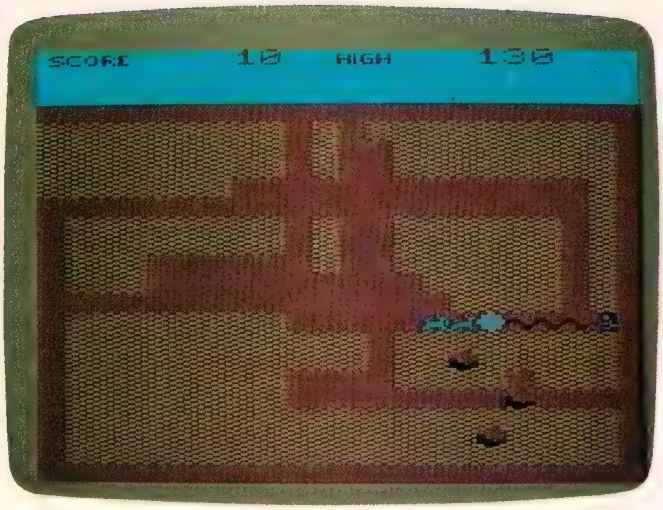


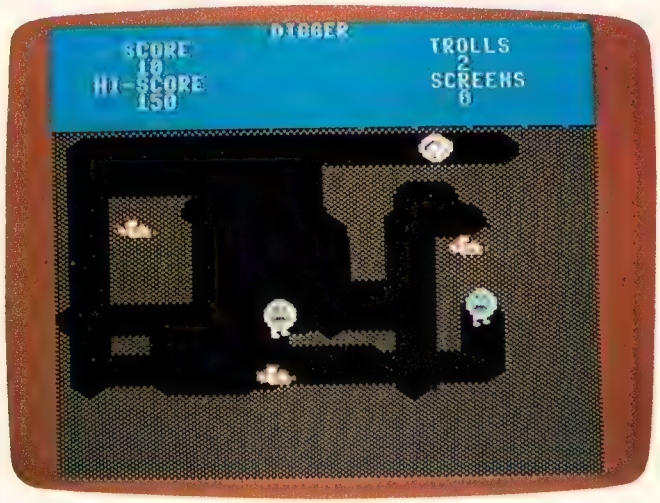
A goat is immobilized and inflated with the air hose (VIC version).

following line, pressing RETURN at the end:

```
POKE36869,240:POKE36866,PEEK(36866)OR1
28:POKE648,30:POKE44,32:POKE32*256,0:P
RINT"{CLR}"
```

Now load and run VIC MLX and enter 4097 and 7684 for the starting and ending addresses, respectively. If you don't want to enter the whole program in one sitting, be sure to enter the above line each time before you load MLX. When you're finished typing in Digger, save it to tape or disk. To run Digger, load the program into an *unexpanded* VIC and type RUN.

See listings on page 138.



A troll has just met his demise by the stone (bottom of screen) in the 64 version.

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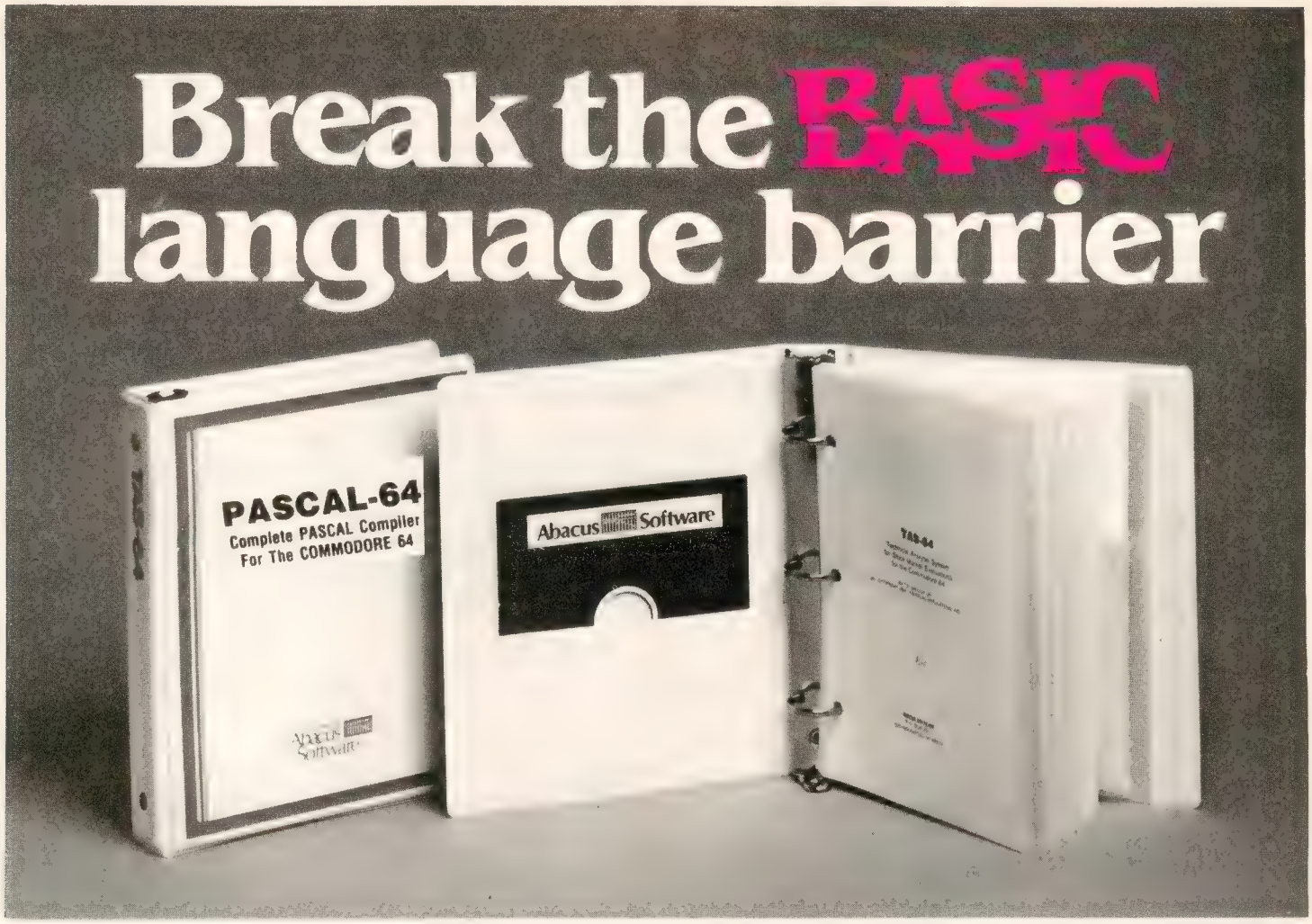

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"Easy-Play" Computer Peripherals For The Family

Fred D'Ignazio, Associate Editor

My First Teaching Machine

Ever since I was little, I have been fascinated by the idea of self-directed learning—learning at home, learning on the job, learning outside classroom walls. Associated with this fascination has been the compelling belief that an average person could learn almost any subject if it was taught right.

Even the most complex subjects—computers, mathematics, astronomy, physics—can be exciting and understandable if they are introduced correctly to a beginner. What matters is *how* they are introduced.

When I was a kid, I sent away for a "teaching machine" advertised in the mail by Grolier, Inc. I had visions of the machine teaching me all sorts of exotic subjects like analytical geometry, nuclear physics, and molecular biology. I saw myself zooming ahead of the other kids in my class and skipping grades right on through college.

When the machine arrived, it was just a blue plastic box, and I was terribly disappointed. The machine let me take "courses" by placing a stack of lesson pages inside the box. The box was really just a "high-tech" textbook with multiple-choice questions at the end of each lesson. I rolled the pages through the machine, and the questions appeared in a little window at the top. When I had filled in my answer, I could open an adjoining window to peek and see if my answer was correct.

The Personal Computer As Teaching Machine

When personal computers began appearing on the scene in the late 1970s, my hope was revived that here, at last, was a teaching machine that I could use to learn all sorts of new things. Unfortunately, the early computers were such primitive devices that I spent most of my time trying to master the computer itself, and very little time learning anything else.

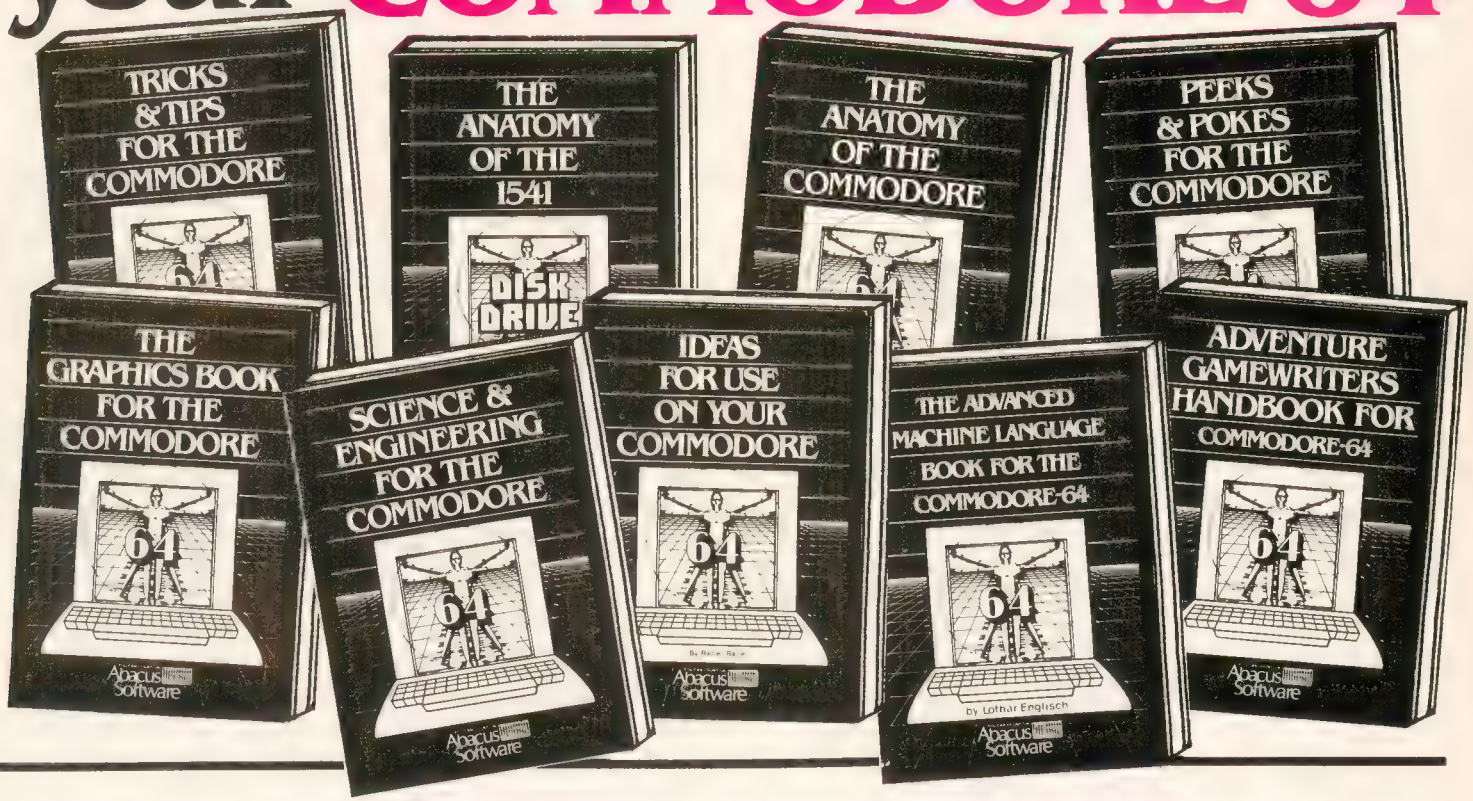
Turning Beginners Into Experts

As the personal-computer revolution advanced, I discovered that there were many other people who shared my interest in using computers as teaching machines. A couple of years ago, for example, I had a conversation with Alan Kay, one of our country's leading computer scientists. At the time he and I talked, Kay was working on the Smalltalk project at Xerox's Palo Alto Research Center.

Although Smalltalk was an extremely advanced "operating environment," Kay was frustrated because it did not measure up to his vision. Kay wanted personal computers to lead naive beginners efficiently and painlessly into any subject until they would be thinking and acting like experts.

Kay and his colleague Adele Goldberg tested Smalltalk by ushering a steady stream of children, musicians, artists, businesspeople, and homemakers through their labs at Xerox. Everyone played with Smalltalk while Kay and

Required Reading for your COMMODORE 64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Goldberg watched. They learned that Smalltalk was, indeed, a simple yet powerful personal-computer environment. Even little children could operate it at a superficial level. But Smalltalk did not, on its own, convert a beginner into an expert in any subject.

Pathways To Powerful Ideas

Another person fascinated with using the computer as a "self-directed learning machine" is Seymour Papert of MIT. In his work in MIT's Artificial Intelligence Lab, Papert has attempted to build pathways beginners can follow to learn more about new domains of knowledge—what Papert calls "powerful ideas."

In his landmark book, *Mindstorms: Children, Computers, and Powerful Ideas* (Basic Books, 1980), Papert wrote about how even young children can learn complex concepts and subjects by using the programming language Logo, and various "discovery learning" methods that Papert introduced during the 1970s in his AI Lab and in various Boston-area elementary schools.

Today Logo has become a major educational computer language. However, educators are just beginning to realize that Logo, on its own, cannot do all the wonderful things Papert envisioned. On its own, Logo is a rather simple graphics and list-processing language. Like Smalltalk, and like my Grolier teaching machine, Logo is not the vehicle that automatically whisks eager beginners into new realms of knowledge.

Easy Learn Vs. Easy Play

Today there's a flood of new software products and peripherals appearing on the market for personal computers like the Commodore 64. Recently I've noticed the use of the word "Easy" as a prefix to many product names—such as *Easy Key, Easy Type, Easy Play,* and so on. To read the manufacturer's claims for its products, you'd think that the age that Kay, Papert, I, and many others had hoped for had finally arrived. "With these simple yet powerful tools," claim the manufacturers, "you can learn to use your computer to ---------- (fill in the blank) like an expert in just a few minutes."

The age of "Easy Play" has indeed arrived. With the right software, your Commodore computer can now fit in the same category as your Easy-Click camera, your Easy-Roast microwave oven, your Easy-Music organ, and your Easy-Goal foam rubber football.

With "easy-play" software and peripherals, personal computers are on their way to becoming mass-market home appliances, because to be mass-market they must be an appliance that everyone can operate. But the question is this: When you operate your computer, are you learning anything?

So far, manufacturers have not converted computers into total black boxes with their "easy play" mass-market philosophy. They have created products that can be operated at two levels—the easy-play, beginner's level and the expert level—but there is nothing in between.

If you're a beginner and you just want to sit down at your computer and make fantastic doodles, then you can use the easy-play mode. Or, if you are an expert, and you are already trained in visual arts, music, or whatever, you can read the manufacturer's manual and do serious work (or serious play) on the computer.

But what if you are somewhere in between? How do you go from easy-play to the expert level? So far, there are no products that offer this feature—and make it work.

Beyond Computer Popcorn

In January 1984, I wrote an article called "Computer Popcorn" for my "World Inside The Computer" column in COMPUTE!. In that article I described new products like the KoalaPad touch tablet from Koala Technologies and the music-composition program, *Music Construction Set* from Electronic Arts, as popcorn: They were so good that once I started using them, I couldn't put them down.

But I have now.

For me, "computer toys" are still fun, but *they aren't taking me anywhere.* They're great for doodling and "fooling around," but I no longer learn when I use them. In fact, they have taught me very little. They are too diffuse, too open-ended, too undirected. They are super tools, but I have only the fuzziest idea about how to make them work.

Plus, they make me feel guilty. After all, they have such great learning potential. Why am I so dumb and so lazy that I can't pick them up and learn on my own? After all, Beethoven and Picasso never had a personal computer, and look how well they did.

Skating Along The Surface

Last spring I moderated a panel at the Billboard Conference on Computer Software. Bill Budge, the designer of *Pinball Construction Set* and other marvels, spoke at that conference and said that he was worried that software designers were designing new products that might outstrip people's ability to use them. The products were getting so deep, so powerful, and so complex, that they were intimidating to the average user.

Today, after looking at some of the new fantasy games, some of the graphics and music-

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synthesizer products, and some of the new productivity tools like Lotus's *Symphony*, I agree.

And what a shame. The personal computer revolution is not succeeding if all we can do is create more and more powerful computer tools and make them off-limits to regular human beings. It's terribly frustrating to read about newer, more powerful computer tools and realize that if I used them I would spend all my time skating along the surface and never learn how to plumb their depths.

A Hidden Curriculum

Because the new computer tools are dazzlingly complex, many manufacturers have incorporated an "easy play" operating level for most of us, and they have thrown in the "expert level" commands to try to appeal to people who already know what they're doing in a particular area.

But how about something in between? How about a *hidden curriculum* for the thousands, or millions, of us who are eager—but very timid—learners, who want to learn some of the tricks of the experts but who want to remain in control and not just "play" the computer like a black box?

Unfortunately, a hidden curriculum does not translate into more user-friendly manuals, help screens, mice, or icons. These give us a firmer grip on the computer "lever," but they don't tell us how or where to direct the lever.

Likewise, onscreen tutorials and computer activity books are also not part of this curriculum. Tutorials teach us only the *mechanics* of the tools, not how to use them artfully, expertly, and creatively. And activities are things we do when we have reached a learning plateau, and when we need to practice skills we have already learned. But first we need someone—or something—to teach us the skills.

What we need are tools that teach us about themselves *and* about the powerful ideas that underly their existence. We need music products that give us a grounding in musical theory and composition; graphics products that teach us about art, drawing, and painting; flight simulators that teach us what all those controls on the dashboard are for; and astronomy programs that start with the sun, the moon, and the Big Dipper, and not some fictitious faraway galaxy.

We need the manufacturers to put us on some kind of learning path—the hidden curriculum—without shackling us to anything that would be too long, too technical, or too demanding for a home recreational environment. The curriculum should have as its goal, through *directed play*, the mastery of different techniques commonly associated with expertise in a given field.

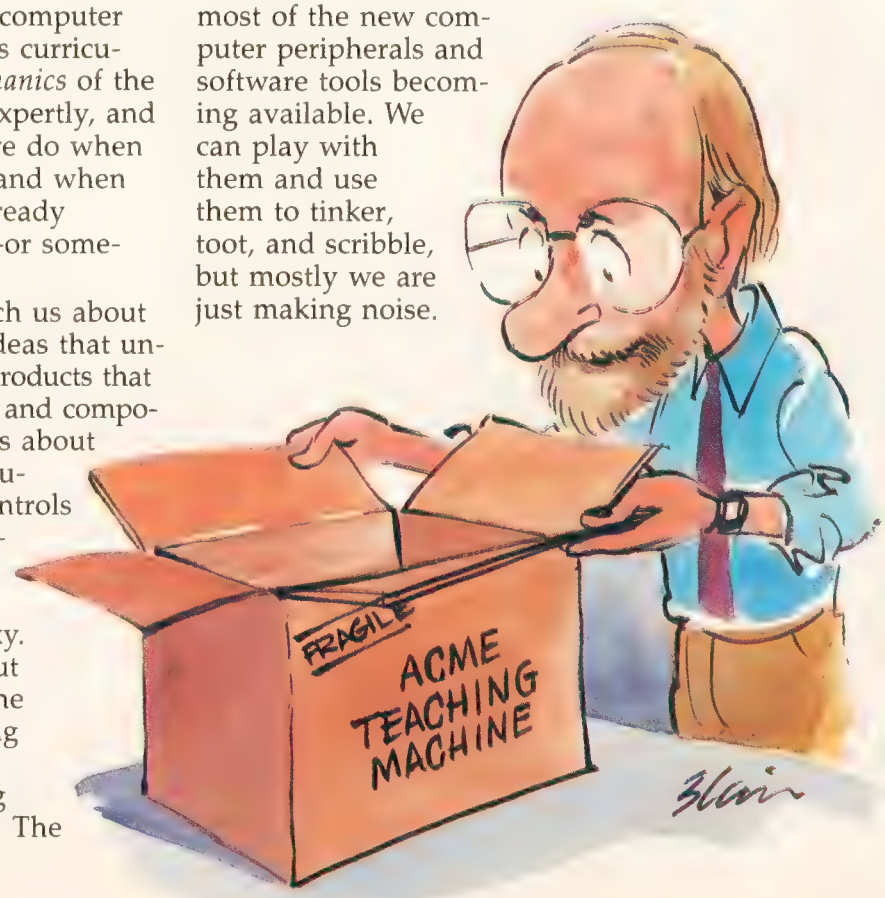
After a person learned a technique, he or she would be free to play with it on a word processor, music processor, art processor, or whatever. Then return to the curriculum and learn something new. A person could continue dipping into the curriculum as schedule and interest allowed. And the reward for following the curriculum would be the incremental mastery of all the features offered by the software tool. A beginner could take pleasure knowing that the result looked like it was done by an expert. And that the expertise acquired and the music or artwork created were not just computer sleight-of-hand.

Self-Teaching Tools

When I was a child, I had a fantasy that one day I would slip into an empty orchestra pit and be allowed to play with all the musical instruments the musicians had left behind. I saw myself playing violins, oboes, harps, and grand pianos. I tooted tubas, banged on drums, and strummed bass violins like a jazz virtuoso.

Now, as an adult, I realize the futility of this dream. Even if I had been left alone with a score of musical instruments, I wouldn't have been able to play them. No one had ever taught me how.

The same is true of most of the new computer peripherals and software tools becoming available. We can play with them and use them to tinker, toot, and scribble, but mostly we are just making noise.



But what if the tools taught us the powerful ideas embedded inside them? Then they might become the teaching machines I dreamed of as a child.

Some Easy-Play Toys For Your Commodore 64

The theme of this month's GAZETTE is "computer peripherals," so I'd like to mention a few peripherals that have the greatest potential to become self-teaching tools—if they are supplemented with the right print materials and software.

In fact, the major limitation with the products I'm going to mention is the scarcity of *any kind* of support materials. On the other hand, all the products mentioned below are "plug-and-go" products. You plug them into your 64, and at least you can do something.

Educational Keyboards

The Muppet Learning Keys keyboard from Koala Technologies (with Sunburst and Henson Associates) is intended for children ages 3 and up. It features colorful graphics, big letter keys arranged in alphabetical order, and all sorts of useful keys like Go, Stop, Oops, Zap, Eraser (which looks like a pink rubber eraser), and Help. One disk comes with the keyboard, but much more software and print materials are needed to turn this product into an entry-level keyboard and reading, writing, and arithmetic tutor.

Some software packages are appearing with their own keyboard overlays. Three CBS Software products, for example, come with EasyKey, a plastic keyboard overlay produced for CBS by Neosoft, Inc. One of these products is *Letter-Go-Round*, written by software designers at the Children's Television Workshop (CTW is the home of Sesame Street and Big Bird). *Letter-Go-Round* is a simple letter-matching and spelling game, but it is significantly enhanced by the EasyKey overlay. The overlay fits atop your Commodore 64 keyboard and "customizes" the keyboard for the *Letter-Go-Round* program. Instead of having to cope with dozens of keys arranged in a mysterious order, your child just has to search for pictures of Grover, Barclay the dog, Cookie Monster, and a big pink Stop button.

Touch Tablets

The two favorites around our house are Koala Technologies' KoalaPad and Suncom's Animation Station. Both pads come with lots of separate software packages and a drawing program (on disk). Animation Station also has helpful features like an Undo button (to undo mistakes), a holder for the plastic stylus you use in drawing on the tablet, and a pair of legs to prop up the tablet on the table where you are working. In addition, *DesignLab*, the drawing program that comes with Animation Station, has a wraparound menu that lets you view your picture and the drawing commands at the same time; a variety of character fonts for labeling and titling your drawings; and other color-selection and "cut-and-paste" commands.

However, both products lack self-teaching materials and a "hidden curriculum" that would make them much more educational than they are now.

Musical Keyboards

Many companies are beginning to make musical keyboards for the Commodore 64, including Waveform, Inc. and Sight & Sound Music Software, Inc. The Waveform keyboard is a flat, membrane keyboard with a cable that attaches to the Commodore 64 via user port 1. Sight & Sound's keyboard is a plastic overlay that slips over the top of the Commodore 64 keyboard. Each keyboard includes 25 keys spanning two octaves. Both companies back up their products with an impressive array of music-synthesizer software. However, my family has taken a liking to the Sight & Sound keyboard for three reasons: It has more musical games (such as "Tune Trivia," "Music Video Hits," and "Solid Gold") for the family to play; it has a disk (*3001 Sound Odyssey*—sold separately) that teaches you some of the fundamentals of operating a computer music synthesizer; and it has "real keys" that move up and down instead of flat, membrane keys.

Both products have great potential but lack a hidden curriculum or "courseware" to introduce the rank beginner to music's many powerful ideas.

Light Pens

Two fairly inexpensive light pens for the Commodore 64 are the Edumate light pen from Futurehouse, Inc. and the Tech Sketch light pen from Tech Sketch, Inc. The Tech Sketch pen comes with the *Micro Illustrator* graphics-and-drawing program. Futurehouse sells the *Peripheral Vision* drawing program for its Edumate pen, but you must buy it separately.

Both pens are easy to use, and the drawing programs are a lot of fun. Also, Futurehouse has a variety of educational and productivity programs for the Edumate pen that enable you to use it as an alternative to the computer keyboard. However, neither pen has materials that teach an unskilled beginner how to create any advanced art or graphics beyond making circles and boxes

and filling them in with pretty colors. Both pens have great potential as self-teaching tools once the right software and print materials are made available.

The Muppet Learning Keys (includes Sunburst disk)
Koala Technologies Corp.
3100 Patrick Henry Drive
Santa Clara, CA 95052-8100
(408) 986-8866
$79.95

Letter-Go-Round *(disk and EasyKey included)*
CBS Software
One Fawcett Place
Greenwich, CT 06836
(203) 622-2500
$34.95

Koalapad (drawing program included)
Koala Technologies Corp.
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(408) 986-8866
$99

Animation Station (drawing program included)
Suncom Inc.
260 Holbrook Drive
Wheeling, IL 60090
(312) 459-8000
$89.95

Colortone Keyboard (music program included)
Waveform Corporation
1912 Bonita Way
Berkeley, CA 94704
(415) 841-9866
$79

The Incredible Musical Keyboard (disk/books included)
Sight & Sound Music Software, Inc.
3200 South 166th Street
New Berlin, WI 53151
(414) 784-5850
$49.95

Edumate Light Pen (pen and Peripheral Vision *drawing program)*
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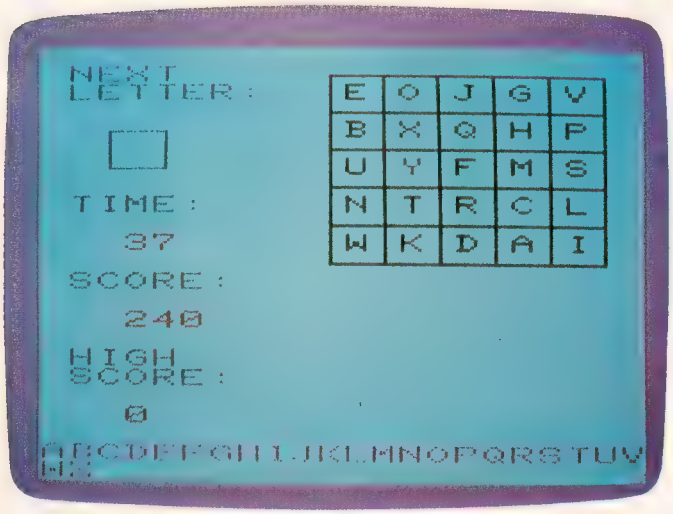
Alpha Anxiety

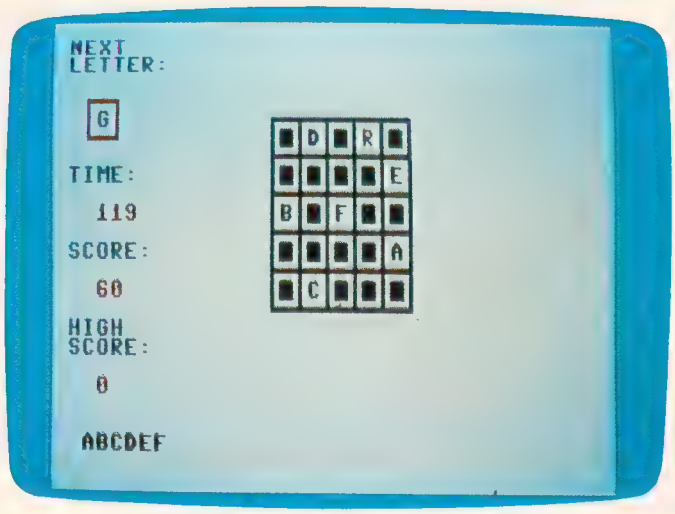
Craig Howarth

Sure, everyone knows the alphabet—but how well? You may go back to the ABC's after tackling this puzzle. It's a good example of a program that's educational for children, and entertaining for game players of all ages. The article includes simple program modifications to make the game playable for children. For the VIC and 64. A joystick is required.

You can probably recite the alphabet without even thinking, although some people have to hum the alphabet song to get it right. "Alpha Anxiety" makes the seemingly simple scenario of naming the letters of the alphabet a difficult challenge. The game displays a five-by-five grid (a total of 25 boxes) containing each of the letters of the alphabet except Z. The computer randomly places letters behind each of the boxes at the beginning of each round of play. Your job is to move to a square using a joystick (port 2 on the 64) to reveal the hidden letter. When you find the letter A, press the fire button and A is permanently displayed. Next, move to B, C, and so on. That's easy enough, but that's only the beginning.



The first round is nearly completed (VIC version).



Searching for a G in the 64 version of "Alpha Anxiety."

The Going Gets Tough

Finding the letters in the right order isn't so difficult, but finding them within the time limit is. You start with 150 seconds, plenty of time—or so it seems. The time allotted for any following rounds is based on how well you did in the previous round (time = previous time remaining × 2 + 40). So, even the first round cannot be taken lightly. You are penalized for slow play, and rewarded for speed.

To make matters worse, if in your hurry to beat the clock you choose a letter out of sequence, ten seconds are deducted from your current time. If you accidentally press the fire button while on a letter already chosen, there is no penalty (although in later rounds a penalty is given—see below). Ten points are awarded for each correct choice. Your score builds from round to round, but one bad round (not beating the clock) can wipe you out and end the game.

When you reach 1500 points, the rules change. You must find the letters in reverse sequence—Y to A. Be sure to keep an eye on the "Next Letter" indicator at the top left corner of the screen if you're having trouble with the sequence. At this level, any keypress other than the correct one costs ten seconds. If you reach 2500 points, the "Next Letter" indicator is no longer displayed, although the reverse sequence is still in effect (look at the bottom of the screen if you forget which letter is next).

If your score reaches 5000, your average time per round is computed and this becomes your time for all subsequent rounds. But, for every 1000-point increment up to 10,000, five seconds are subtracted from your starting time for each round. After 10,000 points, no changes are made to game play.

As the game gets increasingly difficult, you may want to use a "look ahead" strategy. For example, if you need the letter B, look also for C and D. Once you find B, you won't have to search for the next two.

Modifying The Game

Alpha Anxiety is challenging for adults. Children who aren't dexterous with a joystick or haven't memorized the alphabet may find they don't have enough time to complete the first round.

To make the game more educational and practical, you can increase the allotted time. Change the value of DL in line 260 (VIC version) or line 220 (64 version). Also, you can make the game easier by changing the equation for computing time for the next round. To do this, change 40 to a higher number in line 970 (64 version) or line 1010 (VIC version).

See listings on page 125.

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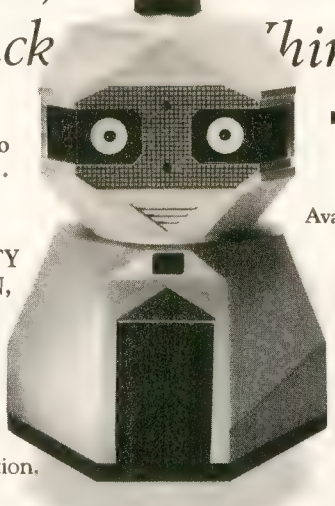

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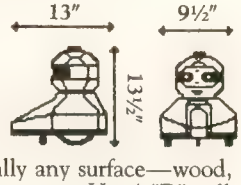

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AVAIL:
A Very Artificial Intelligence Lesson

Tom Prendergast

Give your Commodore a little personality with this short program. It demonstrates the basic principles involved in creating artificial intelligence. For the 64, VIC, Plus/4, and 16.

Do you ever get frustrated with your computer and all those SYNTAX ERRORs it throws at you when you're trying to program? It's not really the computer's fault, though. It's the way it was "hard wired," very businesslike and impersonal. In fact, it's downright inhuman.

So, how about plugging a little human warmth—you—into the computer? You can do that by feeding your Commodore computer this AVAIL program. Your computer's response may be so human that you'll be glad to get it back to its usual state.

First, though, let's talk a little about *artificial intelligence*. AI, as it's often abbreviated, is a term coined by John McCarthy back in 1956 B.C. (Before computers were on chips) for a summer symposium at Dartmouth College. They were very optimistic back in the dark ages of computers. Most people at the Dartmouth conference were sure somebody would be able to program a computer to think like a human being—not like an adding machine—in the next year or so. But they were much too optimistic, as it turns out, because it's almost 30 years later and nobody's succeeded in doing that.

Not The Way We Think

A computer "thinks" in binary—yes/no, on/off, right/wrong—but the way a human being thinks is usually in very fuzzy logic, in "maybes" instead of rights or wrongs, correct or not correct.

There have been programs which can fool people into thinking that the computer is thinking. Probably the most famous is Weizenbaum's *Doctor*, or another version called *Eliza* after the beautiful Cockney girl who was taught to sing about the rains in Spain in very proper upper-class English. *Eliza* was originally programmed in COMIT, a pattern-matching language designed to match and "mask" patterns of English words and phrases. And this is what our AVAIL program does, except it does it in BASIC.

The trouble with a program like *Eliza* in BASIC is that your computer's BASIC "interpreter" has to translate every single byte and bit of your English into binary code, then put it through thousands of steps of processing, determine the right SYNTAX for the replies from "look-up tables," and then go through the whole business in reverse, retranslating from binary back into English for you. If you try an *Eliza*-type program on your home computer, you may find yourself waiting a while for a reply.

AVAIL, however, will give you snappy answers in just microseconds after you press RETURN. But there's a penalty for this speed. Sometimes the computer's English is so bad that it's pitiful. You can call this a "bug" if you will, but I think it gives the program a loveable human quality—almost as if you were talking to a precocious three-year-old. In fact, it might seem there's a little person back there behind the screen. And as you continue with the program and the computer "learns," it starts sounding more like a ten-year-old, an eleven-year-old, and then a fresh teenager. So be careful what you say. Your computer picks up things so fast that it

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may tell you a lot you'd rather it didn't. At the very least, you'll find out how difficult our English syntax is for anyone not born to it.

Like Learning A New Language

Essentially your computer starts off with a blank memory slate, much like we did when first born. It doesn't know a word of non-BASIC English. Remember that it's learning English the way you learned BASIC when you first started out—word by word. So you have to teach it every word of its new vocabulary, and also how we put those words together in English. This won't take very long—several inputs on your part and the two of you are off and rolling. Lines 20–50 are the input module, which allows you to use commas without your getting those EXTRA IGNOREDs from regular INPUT. You could replace these four lines with a one-line INPUT IN$, but then you wouldn't be able to use commas or any other punctuation in your dialogue. It's also a nice routine to add to your bag of tricks.

Lines 60–120 and the subroutine at line 200 break up your input sentences into individual words so that the words of your IN$ sentence become substrings of IN$: Word no. 1 becomes W$(1), word no. 2 becomes W$(2), and so on. This is so the computer can rearrange and play the words back in the correct *order*—which, if you recall your high school grammar, is what SYNTAX essentially is. (Syntax is from the Greek syn + tassein, meaning to put in order.)

Line 130 transfers the words to another string array—W$(1) becomes X$(1), W$(2) becomes X$(2), and so on, so that they can be processed further, and empties the first array for another go-round when we return to line 20 for fresh input and an even fresher reply.

The subroutine in lines 210–400 is a pattern-matching syntax table that changes "you" to "I" and so on. Line 370 is a little tricky and you may want to change it later to "W$(I)=X$(I)" not X$(I+1), but it will give you a few surprises as it is.

Now we're at line 160. After you've seen the computer's reply, if you press RETURN you'll get another "?:" prompt. But if you type N (for "No—it's not OK") when the computer asks if it's OK, then the program performs a GOSUB to 410 for a more or less random response.

Here's what you can expect when you run AVAIL:

An input prompt "?:" will appear, signaling you to type in your first question. Type anything you wish and enter it by pressing RETURN. The computer will respond immediately (The computer's response is shown in CAPITAL LETTERS in the sample run below.)

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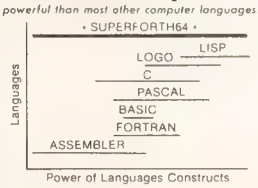

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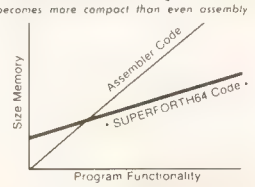

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```
?: (You) How are you, little buddy? [Hit RETURN]
(Computer) HOW ARE YOU, LITTLE BUDDY OK?

?: What's your name?
WHAT IS MY NAME, LITTLE BUDDY OK?

?: Is that your name? Little Buddy?
IS THAT MY NAME LITTLE BUDDY OK?

?: That's not what I meant!
THAT IS NOT WHAT YOU MEANT OK?

?: How can I explain this to you?
HOW CAN YOU EXPLAIN THIS TO I OK?

?: That's lousy English, you know!
THAT IS LOUSY ENGLISH, I KNOW TO I OK?

?: And that's even worse!
AND THAT IS EVEN WORSE KNOW TO OK?

[You type "N" for No, it's not OK]
NO? WHAT'D YOU EXPECT ME TO SAY?

?: Syntax error!
SYNTAX ERROR EVEN WORSE OK?

?: And you forgot the line number
AND I FORGOT THE LINE NUMBER OK?

?: I wonder if you'll ever learn English?
YOU WONDER IF YOU'LL EVER LEARN
ENGLISH OK?

?: There's more truth to that than poetry!
THERE IS MORE TRUTH TO THAT THAN
POETRY OK?

?: You can say that again!
I CAN SAY THAT AGAIN POETRY OK?
```

See listing on page 124.

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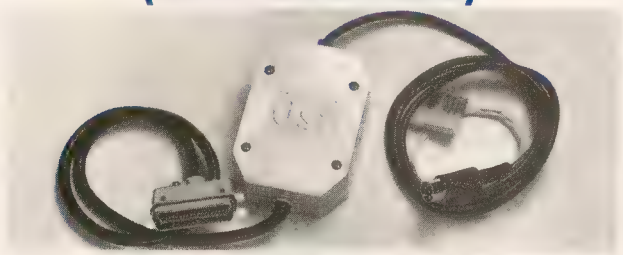

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User Group Update

When writing to a user group for information, please remember to enclose a stamped, self-addressed envelope. When calling a user group, please don't forget to take time differences into account, and call during reasonable hours.

Send additions, corrections, and deletions to this list to:

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Attn: Commodore User Groups

Changes

The new address for the Tuesday User Group (T.U.G.) is Box 1787, Port Perry, Ontario, Canada L0B 1N0.

Correspondence for the Santa Rosa Commodore 64 Users Group (SRCUG) should now be sent to Rusty Stuart, P.O. Box 4512, Santa Rosa, CA 95402. The phone number is (707) 578-3481.

Mark Bender is no longer the contact person for the Logansport Commodore Club. Inquiries should be sent to the club in care of Howard C. Peoples, 2329 Myers Lane, Logansport, IN 46947. The phone number is (219) 753-9353.

Another user group with a new address is the Lane County Commodore 64 User Group (LCCUG). Information can be obtained by writing the group at P.O. Box 11316, Eugene, OR 97440.

Dr. M. H. McConeghy, former contact person for the Newport (RI) Computer Club, is no longer associated with that group, and asks that correspondence no longer be directed to him. Further information about the club is not available at this time.

The Commodore User Group of Clearfield, Utah, has a new name and contact person. The club can be contacted at the following address: Wasatch Commodore Users Group (WACUG), care of Mike Murphy, P.O. Box 4028, Ogden, UT 84402. The club's bulletin board can be reached at (801) 773-5512.

The Tri-State Commodore Users Group also has a new address. Write to it at P.O. Box 2501, Huntington, WV 25725-2501.

A user group is forming in Brooklyn, New York. Those interested should contact Malcolm J. Gottesman, 1735 East 13th Street, Brooklyn, NY 11229. The phone number is (718) 375-5278.

The listing for The Exchange, a Commodore 64 user group in Long Beach, CA, should be replaced with the following information: C64 Helpers, P.O. Box 9189, Long Beach, CA 90810. The phone number previously listed for the club should no longer be used.

The Central Florida Commodore Users Club has a new post office box number. For information, contact Thurman Lawson, P.O. Box 7326, Orlando, FL 32854, phone (305) 886-0390.

COMCOE, the Commodore Club of Evanston, Illinois, has disbanded.

Commodore Owners of Lafayette (COOL), has a new address. Correspondence should be sent in care of Ross Indelicato, 3942 Kensington Drive, Lafayette, IN 47905. The phone number is (317) 447-1326.

The Commodore Computer Club, Evansville, Indiana charter, also has a new mailing address. Send inquiries to Commodore Computer Club, P.O. Box 2332, Evansville, IN 47714.

The Longview Users Group has a new address: c/o Dorothy Metzler, P.O. Box 9284, Longview, TX 75608. The phone number is (214) 759-0699.

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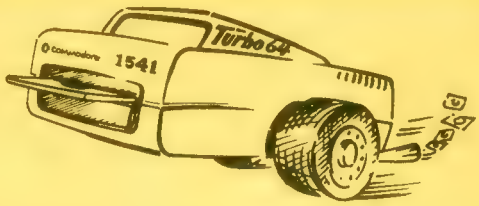

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REVIEWS

Microsoft Multiplan

Harvey B. Herman, Associate Editor

Think back to the early days of personal computing, before the PC was a twinkle in Big Blue's eye. At that time, why would a business want to purchase a small computer? Surely, the cost could not be justified on the basis of all the neat games it would play or its ability to tutor basic number facts. No, there probably was no compelling reason for a commercial firm to buy one until early 1979, when the first spreadsheet program, *VisiCalc*, was introduced.

I am reminded of the now popular theory of evolution called "Punctuated Equilibrium." For the most part, evolutionary change is gradual, but on rare occasions a significant step occurs. Before 1979, small computers had made only a modest inroad into the business community. However, in 1979, the perception of the utility of personal computers for business applications underwent a radical change. Computers running *VisiCalc*, in a few short years, virtually replaced the hand calculated spreadsheets of the past. A milestone had been reached, and it was largely due to this one program and others of that ilk.

Procrastination

I too am in business, the education business, and for years I've envied colleagues who make good use of spreadsheet programs for calculating budgets or averaging grades, using *VisiCalc* or one of its clones. I have the same feelings watching my wife using *VisiCalc* to prepare reports which incorporate extensive calculations. Would I ever be able to do likewise? Well, you have to devote a little effort to learn any new applications software and there always seemed to be some excuse not to bother. However, when I was approached about a review of *Microsoft Multiplan*, it was just the stimulus needed for me to learn the technique that I envied others using and one I was certain I would put to good use immediately. I jumped at the chance.

Most readers know what a spreadsheet is, but just in case some don't, here's a brief explanation. An electronic worksheet, or spreadsheet, is a matrix of rows and columns called cells, containing data, headings, and formulas. Numeric data is entered into cells at the intersection of the grid of rows and columns. The headings are letters, numbers, or special characters, information which makes the sheet more understandable. The formulas, and they can be quite complicated, perform calculations on specified data taken from the matrix of cells.

The power of the spreadsheet depends largely on the way it handles formulas. Change the number in just one cell and any other cell dependent on the same formula will change. Think back to the last time you did your income tax. Wouldn't it be nice if when you refigure your adjusted gross income, all other related "cells" on the IRS form would also change? You might never have to file an amended return again.

Practical Applications

I had a favorable impression of *Microsoft Multiplan* even before I started the review. The opinion of people I trust was consistently favorable. My first impression was also positive. The program comes in a sturdy package with a 427-page looseleaf manual, cheatsheets, and a function key overlay. No preliminary, smudged, mimeographed instructions—a good sign.

I tore open the wrappings, remembrances of birthdays past, and jumped right in. My approach, a method I don't recommend for everyone, is to read a little, try something useful, and read a little more when I get stuck. Most people will prefer to go carefully through the fine tutorial in the manual before attempting a real problem.

The program was easy to load, but I found the initial chatter of the protected disk annoying. When the program begins to run, a blank sheet of

empty rows and columns faces you. What to do?

For review purposes, I set up two typical applications. First, I investigated the possibility of maintaining my grade book with *Multiplan*. Then, I looked at the preparation of a budget with the aid of this spreadsheet program.

For the grade book test, I began with a class of six having three grades each. I've learned that you save yourself a lot of grief if you use a small sample to begin with. In the first expanded column, I typed the student names (alphabetic data rather than numeric): Tom, Dick, Harry, Jean, Jane, and Josephine. In the second through fourth columns, I typed the student grades on each test. In the fifth column, I replicated a formula calculating the student's average grade. Later, I learned how to do this without the need to edit the replicated formula.

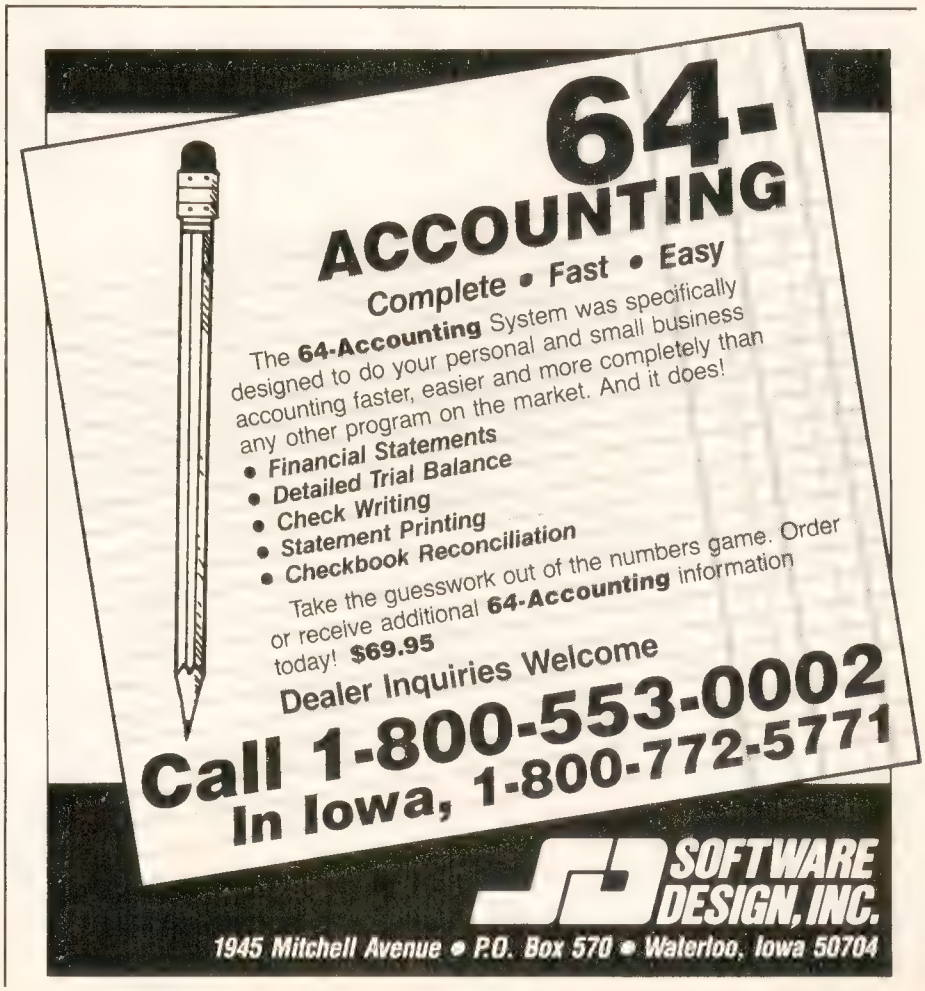
So far, so good, but there were a couple of minor problems. Josephine's name was clipped off, but I was assured by a more experienced user that all letters were saved and could be displayed if the cell was widened further. Also, the decimals in the calculated average weren't quite right. I corrected this easily with the FORMAT command.

Since my familiarity with the program had steadily improved, I had no trouble adding additional formulas which calculated the class average on each exam. The next step, however, gave me a little more trouble.

I decided to pretty things up by adding a two-column title to the sheet. I moved everything down two rows using the INSERT command. However, this messed up the average calculation, as the variables in the formula were absolute rather than relative. For example, you can use the formula AVERAGE using either absolute variables or relative variables. Both calculate the average, but the latter is preferred if the sheet needs to be moved up or down later for any reason. The minor mishap was easily corrected by making all variables relative.

After adding a few more headings, I was ready to print out. The final sheet looks like this:

	1984 Grades			Average
Tom	75	77	89	80.3
Dick	82	85	75	80.7
Harry	71	75	80	75.3
Jean	88	87	82	85.7
Jane	85	90	87	87.3
Josephin	90	87	92	89.7
	---	---	---	
Average	81.8	83.5	84.2	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Incidentally, I also saved the printer output on disk and incorporated the output file directly into the word processor which is being used to write this review.

For the other test application, I prepared a budget. Again, a simple example is best to start with. On occasion I receive fixed sums of money which are to be distributed to the members of the department on the basis of merit. For example, salary increments and research allocations are treated this way. It always takes me a long time fiddling with the numbers to make the sum come out right. Here was a perfect use for a spreadsheet.

I took research allocations as my example. As before, I used an expanded column for names. The second column represented relative merit—the larger the number, the more merit. The third and fourth columns held formulas which calculated the individual allocations for equipment and supplies, respectively. The amount budgeted is shown at the foot of columns three and four. The formula for each allocation divides the relative merit by the sum of merits and multiplies by the amount budgeted for that category. In mathematical terms: rel. merit / sum (rel. merit) * $4000 for supplies. The cells were formatted so only an integer result was displayed.

If this were a real situation, I would now have a template which could be used any time I need to distribute funds. The only figures which would probably change are the amount budgeted and the relative merit. *Multiplan* would then do the calculations in a fraction of the time I could and, more importantly, do them without error.

The final spreadsheet budget is shown below. Again, it came directly from a *Multiplan* file into my word processor.

1984/85 Allocations

	Rel. Mer.	Supp.	Equip.
Tom	5	714	357
Dick	2	286	143
Harry	6	857	429
Jean	8	1143	571
Jane	3	429	214
Josephin	4	571	286
	---	-----	-----
	28	4000	2000

An "Intuitive" Program

The cover of *Multiplan's* manual quotes *Computer Retail News*: "Microsoft's Multiplan may well be the best electronic spreadsheet product on the market." Hype aside, I think it's an excellent program and have no hesitation recommending it.

The program is chock full of features (427 pages worth); it has more functions than I probably will ever use. I particularly liked the instruction manual, the sorting feature (rows only), the help files, and screen read of directory names. The one feature that stands out is that, with just a little practice, the operation of the program becomes intuitive, with only occasional recourse to the manual or help files required.

There are a few negative points which many people won't object to, especially if they are new to spreadsheets. The notation for rows and columns is awkward compared to similar programs. *Multiplan* has no search and replace feature, and sorting, a very useful command, only works on columns. Also, it does not feature pagination on printouts.

Multiplan is protected and can't be copied in the ordinary manner. (However, the company will provide one backup for $10 with proof of purchase.) To avoid wear and tear on the source disk, the manual recommends that you store your worksheets on a separate disk which can be duplicated. Nevertheless, there is no way to avoid wear on your disk drive as the protection method causes the head to kick against its stop. To be fair, *Multiplan* is not the only commercial program that does this.

Other than those few negative points, I believe the program is a great value, considering its many features and relative low cost.

Microsoft Multiplan
Human Engineered Software
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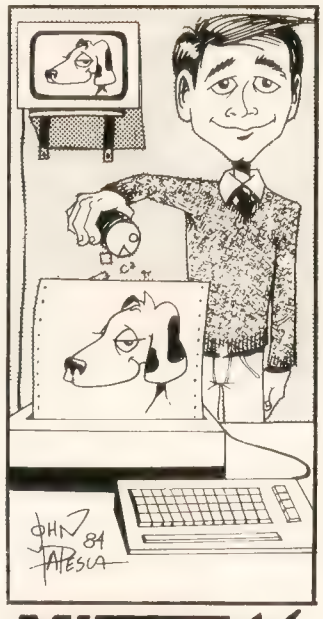

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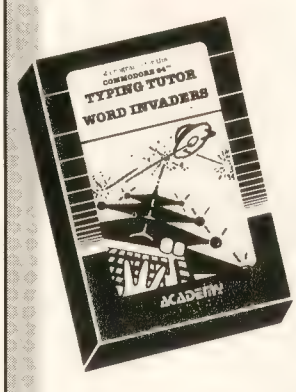

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Also Worth Noting

MicroLeague Baseball

Pro baseball buffs will love this game. Arcade action players may not. In *MicroLeague Baseball*, for the Commodore 64 (Apple and Atari versions available also), you manage a team of your choice by calling the plays and controlling the lineup. On the disk are 25 teams complete with reserve fielders, relief pitchers, and pinch-hitters. Included are many recent World Series teams, the 1984 All Star teams, and several combinations, such as A.L. Greats and Philadelphia Greats. For nostalgia buffs, the '55 Senators are included.

Graphically, the game is so-so, but the audience for *MicroLeague Baseball* won't mind. The game's strength is in providing realistic probability based on real situations with real players. Complete statistics for every player are included for your perusal when you choose starting lineups or go to the bench or bullpen. Documentation is good and includes a rulebook, quick-reference cards for offense and defense, and a rosters and highlights book.

You can play against the computer, manage both teams, or watch the computer manage both teams. Offensive options include setting the lineup, choosing to swing away, sacrifice, surprise bunt, steal, hit and run, and run the bases aggressively or cautiously. Pinch hitters may be inserted at any time. Defensively, you can put any player at any position. (Original lineups are in place if you wish to use them, although in playing the '82 Brewers, the lineup put Ted Simmons at shortstop and Cecil Cooper at second base.) You also call the pitch—fastball, curve, slider, or off-speed/changeup—or opt to pitchout, intentionally walk, bring in the corners (first and third) or the whole infield. A pitching or fielding change can be made at any time.

Research for this game was extensive, as minor details such as fielding range and throwing arm were taken into consideration. Curiously, however, in our first test game, Steve Carlton, pitching in his Cy Young ('80) year, uncharacteristically gave up six runs, seven hits, hit a batter, and threw a wild pitch in just two innings—and we used his best pitches, the fastball and slider.

If the 25 teams included with the game aren't enough, the manufacturer offers other disks: 1982, '83, or '84 teams (American and National Leagues), AL and NL All Star teams, or 1960s, 70s, or 80s World Series teams. Each is $19.95.

MicroLeague Baseball is for serious baseball aficionados and would-be managers. It's sure to bring a lot of joy to Mudville.

MicroLeague Sports Association
28 E. Cleveland Ave.
Newark, DE 19711
$39.95

U. S. Adventure

When an educational computer package can bring a sense of adventure to enhance its instructional value, the result is often a much richer learning experience. First Star Software's *U. S. Adventure* (Commodore 64, Atari, Apple, and IBM PC versions available) is an example of just such a program.

Using the keyboard or a joystick, you move chronologically and geographically across the continent as states join the Union. At the same time, you pick up historical events, matching them to the dates on which they occurred. The program is targeted to preteens and high schoolers, but it's intriguing enough for the entire family to enjoy.

You score points by correctly targeting which states entered the Union and when. Information on the states, their capitals, historical events, and geography are all part of the game play. Enter a time tunnel, correctly identify the date of a certain event, and you accumulate more points.

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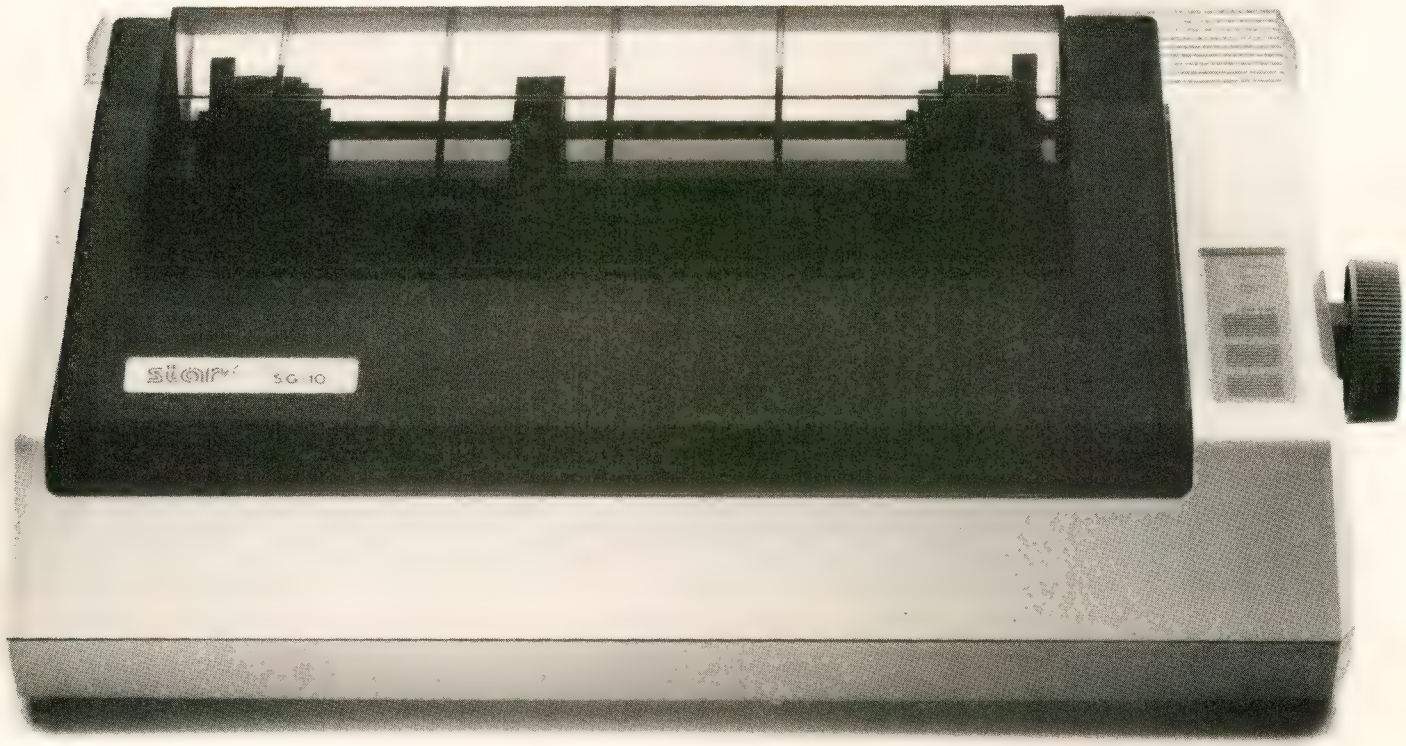

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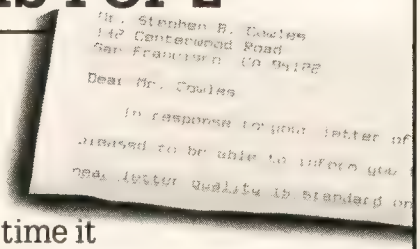
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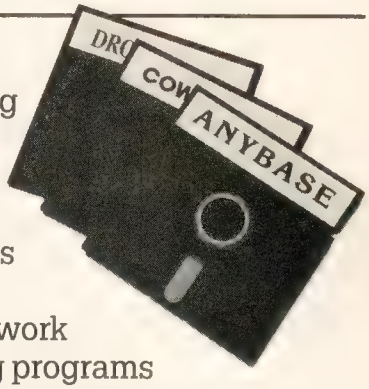

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The high-resolution graphics are well done, as is the documentation. The user's guide includes game play information and worksheets to help you remember historical details as you go through the game. Using an onscreen menu format, you'll quickly find your way around. Although you must move slowly from one state to the next—rather than occasionally zipping across the country as you may wish to—the state-by-state movement reinforces much of the information about each state.

Importantly, the game includes three different levels: Beginner, High School, and Tournament. The first level has HELP options, as does the second level. However, in the High School mode, you must pay with some of your points for every bit of help you request. The Tournament mode lets you wing it on your own.

U. S. Adventure is an intriguing, informative educational package which doesn't sacrifice content to achieve playability.

First Star Software, Inc.
18 East 41st Street
New York, NY 10017
$29.95 (disk)

Up n' Down

A dune buggie, twisting roads, hills to climb, and flags to collect might be all you need for a good arcade game. *Up n' Down*, for the 64, has a bit more. Your buggie can jump, literally leap, from road to road. It can even pop over or crush other vehicles. That's important, for there's an endless stream of strange-looking things coming your way, or trying to run up your rear bumper.

The object of *Up n' Down* is fairly simple: Collect all the course flags (and other objects—ice cream cones, hats, and balloons) that you can find. Jump over the menacing opponents before you end up as a cloud of metal fragments. Complete each course before the time dwindles and your bonus evaporates. It's only the execution of those goals that gets to be a problem.

Coordination and reflexes are important in *Up n' Down*, just as in the video arcade version of this game. You have to press the joystick fire button (or the space bar if you're using keyboard controls) at just the right moment to leap an approaching truck. You have to be quick when you come to a fork in the road. Left or right? There may be an uncollected flag one way, a dead end another. Leaping is an art in itself. It takes practice, and just the right moment, to jump over a vehicle or soar from trail to trail.

The roads scroll beneath you as you drive north. Although you can back up, it's not usually a good idea; there may be something lurking behind you. If you miss a flag the first time, you can catch it the next. The roads wrap around, as if you were driving around the outside of a cylinder. The only thing that's wasted is time, which is important—you're given bonus points based on how long it took you to grab all the flags.

Hills are steep, sometimes you'll have to roll back down and get a running start. But you can pick up speed on the downhill stretches. Displays show how many flags you've already snapped up, and which colors are still left somewhere in the wilderness.

Up n' Down, graphically entertaining, is a frantic race against time and the computer. More often than not, your dune buggie ends up as a pile of metal. Fortunately, you don't have to pay the insurance.

Sega Enterprises, Inc.
Sega Consumer Products
360 N. Sepulveda
Suite 3000
El Segundo, CA 90245
disk or cartridge
(price unavailable)

Guitar Master

If you're a beginning guitar player and own a Commodore 64, you might do well to forego some formal lessons and try *Guitar Master* from MasterSoft. This package, which includes a disk and 78-page instruction manual, is a good introduction to the basics.

The software is menu-driven and simple to use. The main menu offers eight choices: Tuning, Chords, Chord Analyzer, Progressions, Pick and Strum, Transposing, Scales, and Fret Notes. The software teaches well by showing and playing

the exercises so you can see and hear how you should sound, and it lets you learn at the speed you choose. *Guitar Master*, however, can only take you up to a point. Techniques which can really make you sound good (like hammers, pull-offs, bends, and trills—best learned from close work with a teacher) are not—and probably could not be—considered in this package.

The manual is written well and full of clear, useful information. It also teaches timing and standard musical notation. In conjunction with the software, you can learn correct fingering, hundreds of chords, how (and why) they're constructed, major (only) scales, and the principles of transposition. At $49.95, the package is roughly equivalent in cost to five lessons from a private instructor, and it teaches more than any virtuoso could hope to teach you in that time.

MasterSoft
P.O. Box 1027
Bend, OR 97709
$49.95

Eliza

Eliza is not a new product, but many readers may be unaware of this fascinating and instructive "computer psychotherapist" program which traces its history back to a mainframe computer at MIT.

In 1965, computer pioneer Dr. Joseph Weizenbaum created *Eliza* as a spoof of nondirective psychotherapy. *Eliza* asks questions, responds to your answers in nonjudgmental ways, and gently probes your thoughts and feelings. It remains an interesting experiment in artificial intelligence simulation, even if the program routines soon become obvious to you.

The Commodore 64 version of *Eliza* produced by the Artificial Intelligence Research Group has two attributes which make it well worth the $45 purchase price. First, it's a full equivalent of the original MIT mainframe program, employing the same conversational power that makes *Eliza* seem so human. Some other versions available are reduced in power and therefore in function. Second, the BASIC source code is unprotected. You can break into the program anywhere and make all the changes you want. Add color and sound—even speech synthesis. Build the vocabulary. Personalize the program. It's also a good piece of work for beginning programmers to study.

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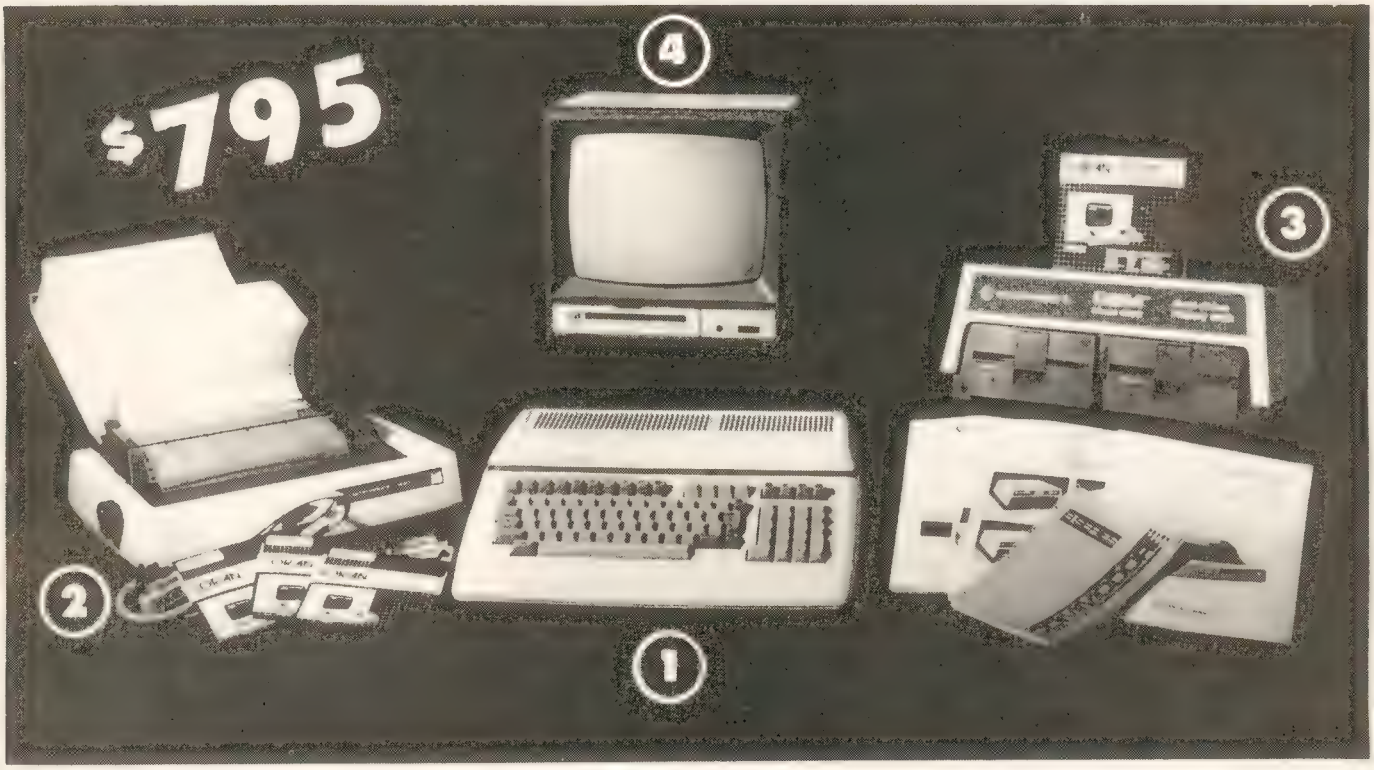

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No. 4023

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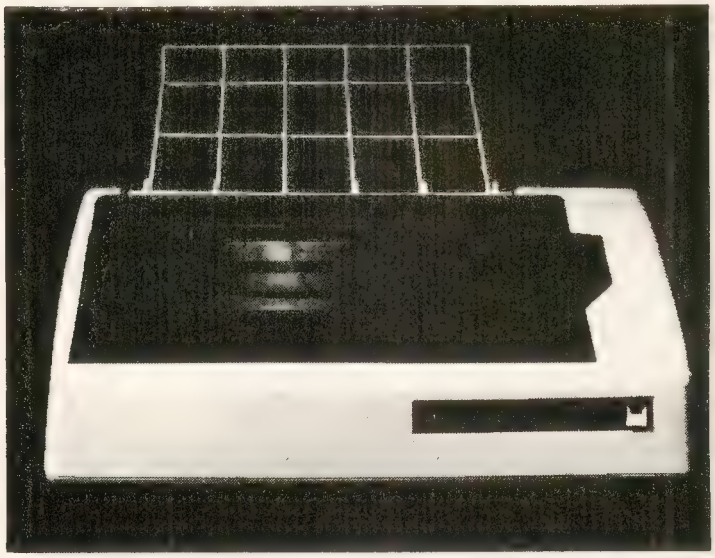

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890-=
abcdefghijklmnopqrstuvwxyz 1234567890-=

The 4023 is a highly advanced 80 column professional tractor/friction printer with full graphics capabilities for custom reports, and program listings. You have 64 programmable characters to define as well as full column and formatting controls. The characters are beautifully created in an 8 X 8 dot matrix. The paper feed is smooth and error free and even includes a paper rack for easier paper storage. The ribbon can be replaced with ease (no mess, easily available cartridge) and will last through 1.2 million characters. You can use single sheet standard paper or continuous forms to make up to 3 copies at one time (3 part forms). This is the best printer value in the U.S.A. For Commodore Computers!

SPECIFICATIONS

PRINTING METHOD
Serial Impact Dot Matrix

PRINT RATE
100 characters per second (CPS)

PRINT STYLE
Correspondence Quality

PRINT DIRECTION
Bi-directional

COLUMN CAPACITY
80

CHARACTER FONT
8 X 8

LINE SPACING
Programmable

CHARACTER SIZE
0.094" high, 0.08" wide

COPIES
3, including original

RIBBON TYPE
Cartridge

RIBBON LIFE
1.2 million characters

RIBBON CARTRIDGE
Commodore P/N613160550

PAPER WIDTH
3" to 10" tractor or single sheet friction

FORMS
7.5 plus (0.5 X 2 sprocket margins)
Pin-to-pin distance: .5" longitudinally
9.5" laterally
5/32" diameter

INTERFACE
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GRAPHICS
64 Programmable graphics

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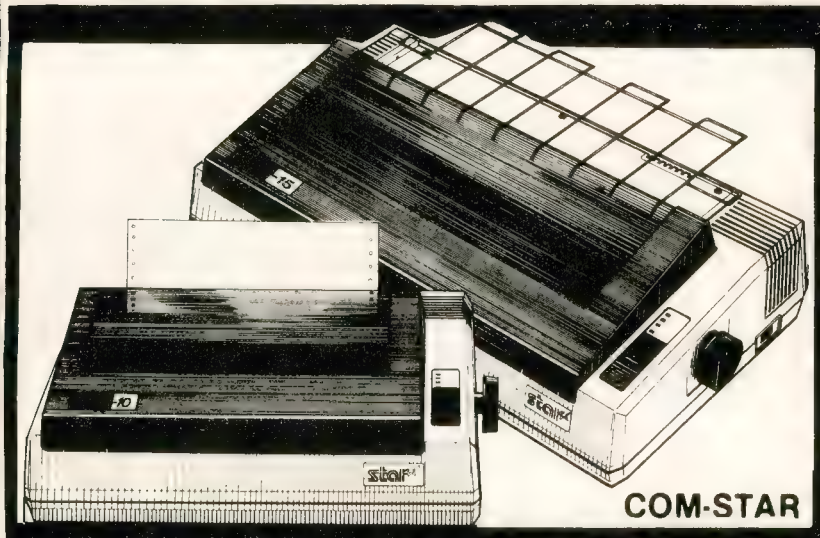

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Has all the features of the 10" COM STAR PLUS +PRINTER plus 15½" carriage and more powerful electronics components to handle large ledger business forms! (Better than Epson FX 100) List $599

SALE $339.00

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COM-STAR PLUS+ Print Example: ABCDEFGHIJKLMNOPQRSTUVWXYZ
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Michael S. Tomczyk

Computer Math For Beginners

Last month we presented a brief introduction to computer math. This month and next we'll look at some more computer math—as well as some important general programming concepts, with emphasis on using variables, our special focus area for 1985.

The heart of this month's lesson is a short little program called "A Simple Adding Machine." Actually, it's simple if you know how it works—but confusing if you don't.

Dissecting a program and understanding how it works is one of the hardest things to learn as a beginning programmer. That's why we're going to spend some extra time this month working with our first program example. We'll start by introducing an "adding machine" program, then we'll walk through it in detail and see how it works. Finally, we'll dress up our program by adding a pinch of this and a dash of that—and learn how to use the mysterious DEF FN command.

Let's first review computer math symbols.

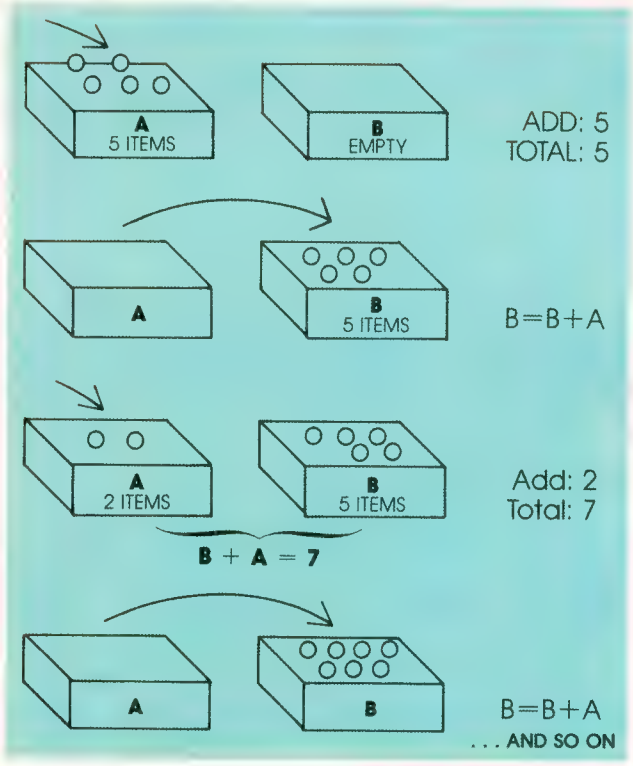
+ for addition (PRINT 4+4)
− for subtraction (PRINT 9−5)
*** for multiplication (PRINT 2*5)**
/ for division (PRINT 10/5)
/ for fractions (PRINT 1/2*1/3)
↑ for exponents (PRINT 2↑3)
. for percent (.12) or decimal (.99)
() for formulas (PRINT (2/5)*(12.5))—always use same number of left and right parentheses

A Simple Adding Machine

We'll start with a simple computerized adding machine. This short program lets you add numbers like a calculator. The program displays the current total, as well as the number you want to add. To see how it works, enter the program, then type RUN and press RETURN:

```
10 PRINT CHR$ (144) CHR$ (147)
20 PRINT "ADD";: INPUT A
30 PRINT SPC (9) "{RVS} TOTAL" B+A:PRINT
40 B=B+A
50 GOTO 20
```

This is a short program, but it contains some unusual BASIC concepts, and an interesting use of the variables A and B. Before analyzing the program line by line, let's take a very simplified look at what this program does, using the accompanying illustrations.



Imagine you have two storage boxes marked A and B. At the beginning, both boxes are empty, which means their value is zero. The computer asks us how many items we want to put in box A and we answer by typing our first number—let's say five—which is stored in the A box.

If we add the contents of both boxes (B+A), the *total* is five items because there are five items in the A box (but the B box is still empty).

Before we can put more items into the A box we have to move its contents (five items) into the B box to make room.

Now we put two items in the A box. This

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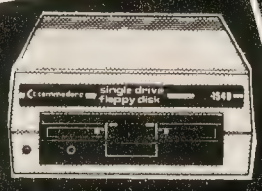

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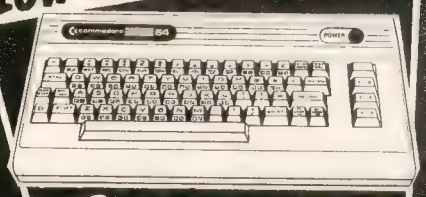

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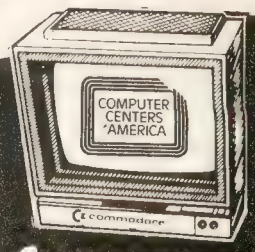

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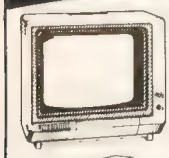

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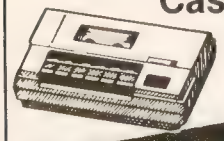

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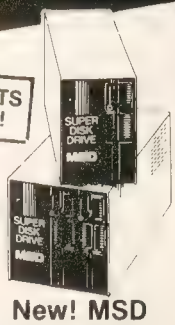

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means the B box holds five items and the A box holds two items, so the total of B and A is seven.

Again, we move the contents of A into the B box, which means the B box now holds seven items. Then we put more items in the A box, and so on. And that, in general, is how our adding machine works. Let's take a look at the BASIC commands to examine the entire program in detail.

Line 10 contains two CHR$ (character string) codes. Every symbol and editing command on your computer keyboard has its own CHR$ code. These codes are listed in a special appendix in your owner's manual. CHR$ codes are used with the PRINT command, *without quotation marks.* You can "stack" or "line up" several CHR$ codes after one PRINT command—for instance, here we used two CHR$ codes on the same PRINT line. CHR$(144) sets the display color to black. CHR$(147) clears the screen.

Line 20 prints the word ADD on the screen (we'll skip the semicolon and colon for a moment). INPUT A automatically displays a question mark (?) and waits for a number to be entered. You might think of A as box A. To put a number in the "box," you have to type a number and press RETURN. Let's say you type the number 5. The variable A, no matter what value it held before, now stands for the number 5. From now on, when we use the variable A, it's the same as using the number 5 (until we decide to put another number in the box).

Incidentally, the semicolon (;) in line 20 is like "programming glue." It links things together. If we left it out, the question mark would appear by itself on the next line down instead of immediately after the word ADD. The colon (:) is used to separate commands whenever two or more BASIC commands are used on one program line.

Line 30 uses the SPC command to print nine blank spaces, then it displays—in reverse characters—the word TOTAL followed by the sum of the numbers represented by the variables A plus B. Since B is "empty" and equals zero, B+A is the same as 0+5 (or 5). The PRINT command all by itself inserts a blank line on the screen between the TOTAL and ADD lines.

Line 40 defines the variable B as the sum of B plus A. What it really does is add the value of A to the value of B so that B now equals (B+A). For example, if B is 0 and A is 5, B now equals 5+0, which is 5. For a moment, both B and A hold a 5, but not for long.

Line 50 recycles the program back to line 20 and asks for a new value for variable A—let's say, the number 2. This time when the program reaches B+A in line 30, B equals 5 and the new A equals 2 so the second total is 7. Line 40 redefines B as B+A which is the same as 5+2. So now B becomes 7 and A is ready to receive another number. The result is an "adding loop." To break out of the loop and stop the program, hold down RUN/STOP and press RESTORE (RUN/STOP–RESET on the Plus/4 and 16).

REM: *You can enter dollar amounts or decimal numbers such as 52.49, but if the outside digit on the right side of the decimal is a zero, as in the number 52.40, the computer will truncate the zero and display 52.4, mathematically identical to 52.40.*

Here's a variation you may want to try which adds a title at the top of the screen, and repeats the TOTAL and PLUS (ADD) lines in the same position every time. You may want to save the previous program on tape or disk, then type NEW and enter this version:

```
10 PRINT CHR$(144): GOSUB 100
20 B=B+A: A=0: GOTO 10
100 PRINT CHR$(147); "{RVS} ADDING MACHIN
    E ": PRINT
110 PRINT "{RVS} TOTAL " B+A
120 PRINT "PLUS";: INPUT A: RETURN
```

This program starts at line 10, uses a GOSUB command to jump down to lines 100–120, then uses a RETURN to jump back to line 20, and repeats the loop.

Line 10 uses PRINT and CHR$(144) to set the color to black, and GOSUB to go to lines 100–120 to display the title and total. GOSUB stands for GO to SUBroutine. It tells the computer to jump to the subroutine in the line specified (in this case line 100). The RETURN command at the end of the subroutine (line 120) tells the computer to jump *back* to the point where it left off in the program.

Line 100 uses CHR$(147) to clear the screen, then on the same PRINT line displays the words ADDING MACHINE in reverse (RVS) characters. The {RVS} means hold down the CTRL key and press the RVS ON key at the same time—you don't need a RVS OFF because the reverse feature is automatically turned off at the end of the line. The PRINT command by itself inserts a blank line.

Line 110 prints the word TOTAL in reverse letters, followed by the current total, which is the sum of variables B and A.

Line 120 prints the word PLUS in normal letters. The INPUT command displays a question mark and waits for the user to type a number, which becomes variable A. The RETURN command signals the end of the GOSUB routine and sends the computer back to where it left off, which was the end of line 10.

Line 20 is executed next. B=B+A is the

same as the previous version. Here, we really empty box A by letting A=0 before we GOTO line 10 and repeat the adding process.

You can modify the program we've been working with to display a running average of the numbers you enter. An average is obtained by adding together a group of numbers, then dividing the total by how many numbers there are in the group. For example, if you have two numbers, let's say 10 and 4, you add them up to get 14, then find the average by dividing the total (14) by how many numbers there are in the group (there are 2 numbers in this group). So 14/2 is 7 and we see that the average of 10 and 4 is 7.

But first we have to learn about something called a *program counter*, which helps us keep track of how many numbers we're adding so we can calculate their average.

Using A Program Counter

A program counter usually adds one to itself each time an action occurs in a program (you could also count by twos or by any other interval). Here's an example of a simple program using a program counter:

```
10 PRINT N
20 FOR T=1 TO 500: NEXT
30 N=N+1
40 GOTO 10
```

Type RUN and press RETURN. To stop the program, press RUN/STOP. The key to this counter is line 30: N=N+1.

Line 10 displays the value of N. But the variable N hasn't been given a value yet—it's still an "empty box"—so the value is zero and the computer displays a zero on the screen.

Line 20 is a *time delay loop*, which is an application of a FOR-NEXT loop. Time delay loops slow down your program. Changing the number 500 to a larger number causes a longer delay and slows down the program. Changing it to a smaller number makes the program run faster. We use a time delay loop here to make it easier to see what's happening. (Incidentally, the variable T in this line can be any numeric variable, but it's a good idea to use T wherever you have a time delay loop because FOR-NEXT loops are used for different purposes and using T helps you identify which loops are time delays.)

Line 30 increases the value of N by one. We say the N "is adding one to itself." One way to look at this line is to think of the first N as the *new* N you want to define, and the second N as the *old* or *current* N, like this: (*new* N)=(*old* N)+1. The first time through the loop, this is the same as saying N=0+1, which is the same as saying N=1.

Line 40 sends the program back to line 10 to repeat itself. This time the computer prints the new value of N, which is 1.

The next time the program goes around, N equals 1, so in line 30, N=N+1 is the same as N=1+1, which is 2. This is how we get N equal to 0, 1, 2—and so on, which gives us a counter.

Sometimes you may want to start the counter at 1 instead of 0. This is necessary if you want to divide the value of N into another number, because the computer will not divide by zero. If you try to divide by zero, an error message is returned. You can avoid this by starting N at a value of 1 by switching the sequence around a bit, like this:

```
10 N=N+1
20 PRINT N
30 FOR T=1 TO 500: NEXT
40 GOTO 10
```

In line 10, the *old* N equals zero because it hasn't been defined yet, so N=N+1 is the same as N=0+1, which is the same as N=1. Notice how this type of counter, beginning with N=1, is used in the averaging program which follows.

Adding Numbers With A Running Average

It's easy to adapt our adding machine program so it keeps track of how many numbers we're adding and gives us a running average. There are many uses for running averages—for example, a teacher might want to add up all the test scores in a class to find the average score. This technique can also be modified to calculate the "mean" and find other statistics as well.

```
10 PRINT CHR$(144): GOSUB 100
20 B=B+A: A=0: N=N+1: PRINT "{HOME}
   {5 DOWN}" "AVERAGE" B/N
30 FOR T=1 TO 750: NEXT: GOTO 10
100 PRINT CHR$(147); "{RVS} ADDING MACHIN
    E": PRINT
110 PRINT "{RVS} TOTAL" B+A
120 PRINT "PLUS";: INPUT A: RETURN
```

The key modifications are found in line 20. Line 10 begins with CHR$(144) which sets the color to black. The GOSUB sends the computer to lines 100–120. Line 100 clears the screen, sets up the title in reverse letters, and uses the PRINT command by itself to insert a blank line on the screen. Line 110 prints the word TOTAL in reverse letters along with the total of B+A. The opening total is 0 because B and A haven't been defined yet. They're still "empty boxes."

Line 120 prints the word PLUS, waits for the input of the variable A, then returns to the end of the GOSUB and moves to line 20.

Line 20 has B "adding A to itself." Then we find our counter. N=N+1 sets the value of N at 1, so we begin our counter at 1. We then use PRINT to go to the HOME position and move

down the screen with five "cursor downs," which gives us the position where we will display the word AVERAGE and the averaging formula.

The averaging formula is simple. As we noted earlier, an average is the total of the numbers being added together divided by how many numbers there are. The first TOTAL is 0 and there is no average yet. If you type the number 1 after the word PLUS, the TOTAL becomes 1 and the average becomes 1 also because the total (B) divided by the counter (N) is 1/1, which is 1. On the second go-round, the counter moves to 2. If the second number you add is 3, the second TOTAL becomes 4 (1+3=4) and the AVERAGE is 4/2, which is 2. This process continues because every time you go around through the program and add another number, the counter keeps track of how many numbers you added and divides the total by how many numbers you've added. The AVERAGE is flashed on the screen with a time delay of 750.

You may want to save this program on tape or disk before going on. Then type NEW and press RETURN to erase it and get ready for the next example.

The DEF FN Command

One of the best computer math tools is the DEF FN (DEFine FuNction) command. DEF FN lets you create a long calculation or formula and plug your own number(s) into the formula and display or use the result in your program.

This command can be confusing because it uses two or three different variables, but it really looks much more complicated than it is. It takes most people a little practice to understand how it works, but the result is worth the effort. Let's look at the *structure* of a DEF FN command:

DEF FN A(X)=(formula containing X)

The letter A is a variable which you insert; it's the "variable name" of the function. If you want to use this function in your program you'll refer to FN A (Function A). You can have several different functions in one program, each with a different variable name.

The X in parentheses determines the position of the *working number* in the formula. In a moment we'll see what a working number is. For now, just remember that we're going to plug in our own working number wherever the variable X appears in the formula. The use of X as a variable here is purely arbitrary. We could use other variables such as N1 or Y just as easily because the only purpose this variable serves is to designate the position of the working number we want to plug into the formula. Confused? OK, let's try a real example to try to clarify things. Here's a simple one:

```
10 DEF FN A(X)=(5+X)
20 PRINT FN A(4)
```

Line 10 contains the DEF FN (DEFine FuNction) command. What this says is that we're going to take a number represented by X and plug it into the formula (5+X). This formula will be called Function A, and from now on when we want to use this formula in our program we'll refer to it as FN A (Function A).

Line 20 is where we use the formula. FN A(4) tells the computer to replace the X with the number 4 in the formula in line 10. PRINT FN A(4) means "calculate and display the result of the formula using the number 4." Got it? Try this example using some other numbers. Try changing the formula from (5+X), for example, to (X/2) or some other formula.

We inserted the number 4 in our example, but you can use a numeric variable obtained from an INPUT statement, too. Type NEW and press RETURN, then enter this example:

```
10 DEF FN A(X) = (X*100)
20 PRINT "ENTER A NUMBER";: INPUT N
30 PRINT "100 TIMES" N "EQUALS" FN A(N)
```

Type RUN and press RETURN.

Line 10 contains the DEF FN command. What this says is that we're going to take a number represented by X and plug it into the formula (X*100).

Line 20 prints a prompt message and asks for an INPUT which is given the variable name N. From now on the variable N is the same as the number you typed in. For example, if you typed 6, then N stands for 6.

Line 30 prints the words "100 TIMES" and then goes outside quotation marks to print the number you typed in (represented by the variable N) and then prints the word EQUALS.

FN A(N) is the Function A formula from line 10 with your number (N) plugged into the formula. If your number is 6, then N equals 6 and FN A(N) is the same as saying FN A(6), which is the same as saying (6*100), which is the same as 600. The computer displays the result from the FN A(N) formula, which is 600.

A reminder if you're still confused: The X in the DEF FN line is *only used for this position.* It tells the computer where to plug in the number or variable. The part of the program that actually inserts the number and performs the calculation is: PRINT FN A(N) or PRINT FN A(6).

Here's a more practical example. Type NEW and press RETURN.

```
10 DEF FN A(F) = 5*(F-32)/9
20 PRINT "FARENHEIT TEMPERATURE": INPUT F
30 PRINT "DEGREES FARENHEIT EQUALS" FN A(
   F) "DEGREES CELSIUS"
40 GOTO 10
```

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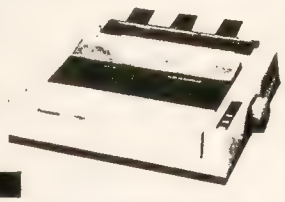

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Now type RUN and press RETURN.

Hold down RUN/STOP and press RESTORE (or RESET) to exit the program, then LIST it.

Line 10 defines the formula. In this case, the formula converts a Farenheit temperature to Celsius. The conversion formula is represented by 5*(F−32)/9 where F stands for any Farenheit temperature.

Line 20 requests a temperature INPUT and assigns the variable F to the temperature number which is typed in.

Line 30 prints the temperature you typed in (remember that variables are always printed *outside quotation marks*), then goes inside quotation marks to display the message DEGREES FARENHEIT EQUALS, then back outside quotes to display the result of Function A, and back inside quotes for the rest of the message.

When you PRINT FN A(F), you're really inserting the Farenheit temperature number represented by F into the formula where the F appears, and printing the result of the calculation which results.

Line 40 repeats the program.

See if you can rewrite this program to convert Celsius degrees into Farenheit. Incidentally, 100 degrees Celsius equals 212 degrees Farenheit, and vice versa—which is one INPUT you can use to test your program to make sure it's accurate.

A DEF FN Rounding Formula

Did you ever want to round off a number? You can use the DEF FN command to do it. Try this:

```
10 DEF FN R(X)=INT(X*100+.5)/100
20 A = 1.6666: PRINT A
30 PRINT FN R(A)
```

The Function R rounding formula in line 10 can be used to round any number to the nearest "penny." To show the difference, first we print the number 1.666 in line 20, then we insert this number into our formula using FN R(A) in line 30 and the result is 1.67.

Here's how the rounding formula would be used to round the averages in our adding machine program:

```
5 DEF FN R(X)=INT(X*100+.5)/100
10 PRINT CHR$(144): GOSUB 100
20 B=B+A:A=0: N=N+1: PRINT "{HOME}
   {5 DOWN}" "AVERAGE" FN R(B/N)
30 FOR T=1 TO 750: NEXT: GOTO 10
100 PRINT CHR$(147); "{RVS} ADDING MACHIN
    E": PRINT
110 PRINT "{RVS} TOTAL" B+A
120 PRINT "PLUS";: INPUT A: RETURN
```

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MACHINE LANGUAGE FOR BEGINNERS

Richard Mansfield, Senior Editor

Memory

Computer memory structure is worth taking a few minutes to learn. After you know the fundamentals, some machine language tasks become easier to accomplish.

The smallest quantity of computer memory is a *bit*. It is so small that it can only have two states: on or off. A bit is quite limited; it conveys very little information. It's like the candle in one of those stories where someone rides by at night looking for your signal: Either the candle is in the window, or it's not. Bits can only signal one of two possible pieces of information: yes or no, on or off, up or down, true or false, the British are coming or they're not.

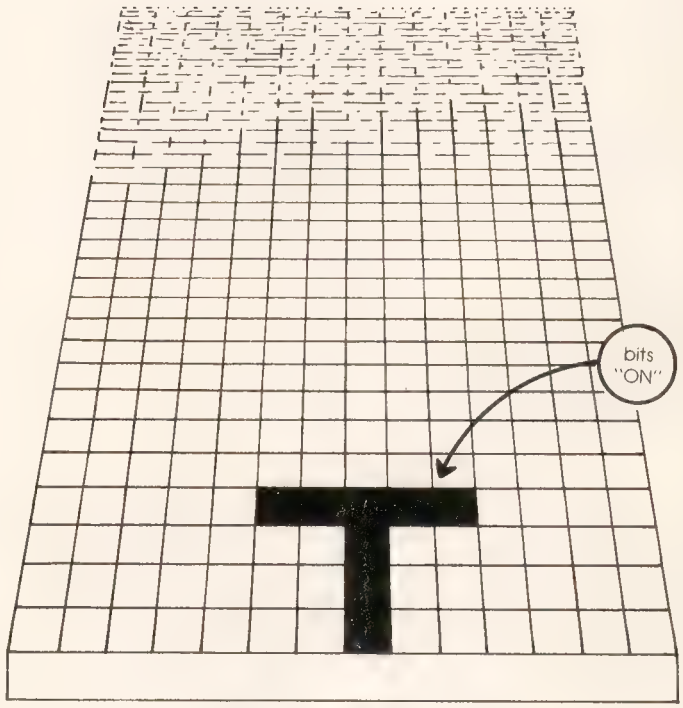
But when you gather many bits together—the Commodore 64 has over half a million bits inside it—you can store and manipulate a great deal of information.

An Immense Honeycomb

When working with computers, we think of a bit as holding either a 0 or a 1. These aren't really the *numbers* 0 and 1, they're just a convenient way of signifying whether a bit is "on" or "off." (The 0 means it's off.)

You can visualize a computer's RAM memory chip as a huge lattice, an immense honeycomb of bits. In the figure below, you can see that eight of the bits are "on" and that, by combining bits together, we've greatly increased our ability to express information. These eight bits are forming the letter *T*.

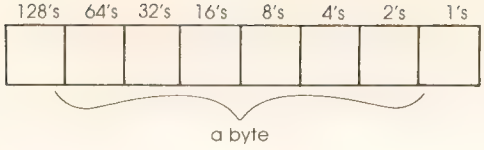
Humans see the letter T in this graphic representation, but the computer stores letters and numbers somewhat differently. Bits are ganged together in bundles, in groups of eight. When you put eight bits together, this new eight-bit unit is called a *byte*.



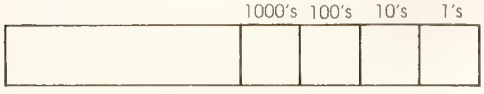
Here's an easy way to keep these ideas straight. Several centuries ago, there was a coin which was soft enough to be cut into eight segments. That's where we get the phrase *pieces of eight*. Each of these segments were themselves used as coins and were called *bits*. The bit coin couldn't be sliced down any further, just as there is no way to slice computer memory any smaller than a bit. We still use the word *bit* this way when we refer to a quarter as "two bits."

When Ganged Together

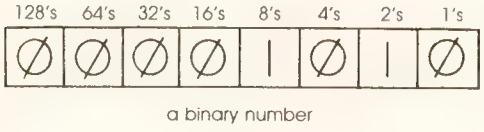
So, a byte is eight bits. Yet even within just eight bits we can store a considerable amount of information. For one thing, we can count up from zero to 255. Here's how:



When ganged together like this into a byte, the bits are each given a different value, depending on their position. The rightmost bit has a value of 1. It's the 1's column. Next comes the 2's column, then the 4's, 8's, and so on up to 128's. This might seem strange, but it's quite like the way we use ordinary decimal numbers:



Notice that a number in the rightmost cell would be in the 1's column, a number next to it would be in the 10's column, etc. But back to bytes: A number made up of bytes is figured the same way, but these byte-numbers (they're called *binary* numbers, meaning they have only two states) have different column values. Each "on" bit is worth (from right to left) 1, 2, 4, 8, 16, 32, 64, or 128, depending on its column position. Can you figure out the value of this binary number?



Calculate it by adding (2) plus (8). As you can see, all you need to do with binary numbers is add the column values wherever you see a 1 and ignore the columns with a zero. The answer is ten.

If there is a one in every column (11111111) the number would be 255. That's why we say that a byte can hold any number between 0 and 255. But how does a byte store a character like the letter A? It's just a code, an agreed upon convention called the ASCII code. All computers know that when they see a byte with this pattern of bits on (01000001) that it means the letter A. 01000010 is B and 01000011 is C.

How Does The Computer Know?

If we think of these bytes as holding binary numbers, they would be 65, 66, and 67. This leads to an interesting question: How does the computer know whether to think of the byte 01000011 as the letter C or the number 67?

It knows by the *context*. If it's doing word processing, it will see these as characters. If it's doing mathematics, they will be seen as pure numbers. There are other contexts, too, other codes. For example, you might write a program that turns your screen blue whenever you enter the number 65. In *that* context, 01000001 doesn't mean the letter A or the number 65 any more; it means the color blue. Bytes are wonderfully resilient—they can mean pretty much anything you and the computer want to agree on. They can even stand for instructions.

If you'd like to play around with binary numbers, type in Program 1. It's a quiz that will show you a binary number and ask you to figure it out. Actually, there's not much real value in knowing how to work with binary numbers, though. It's worth knowing about them, but you don't really need to use them much in most ML programming. You'll probably be using an Assembler program to enter your ML programs and Assemblers can use ordinary decimal numbers.

Nevertheless, there are ML instructions which operate on bits (ASL, ROR, etc.) and so you'll at least want to be able to visualize the bits within a byte. For a complete display of all the binary numbers between 0 and 255, type in Program 2.

See listings on page 125.

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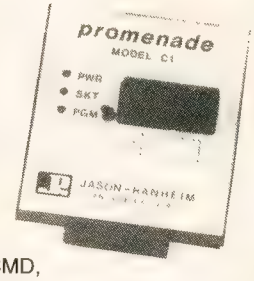

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Abbreviated Printer Codes

John Crookshank

If you've discovered a clever timesaving technique or a brief but effective programming shortcut, send it to "Hints & Tips," c/o COMPUTE!'s GAZETTE. If we use it, we'll pay you $35. Due to the volume of items submitted, we regret that we cannot always reply individually to submissions.

In order to make your printer do special things like expanded or italic printing, you have to sprinkle CHR$(xx) values throughout your program. That's seven or eight keystrokes, not counting the shifting and unshifting.

But did you know there are one-key abbreviations for many of these codes right on the 64's keyboard? The ASCII characters 1–27 are easily accessible by just holding down the CTRL key and pressing another key. It effectively subtracts 64 from the normal Commodore ASCII value for the key being pressed. In other words, the CHR$ value is the same as the position of the letter in the alphabet.

You can use these special codes even if you don't have a printer. As a simple example, CHR$(13) is a carriage return, and M is the thirteenth letter in the alphabet. So CTRL-M should be a carriage return. Sure enough, the combination works just like a carriage return (try it). And CTRL-S acts as a CHR$(19)—the cursor jumps to the home position at the top left of the screen. CTRL-Q is the equivalent of cursor down, and so on. Here's a list of the ASCII values available directly from the keyboard (unfortunately, they don't work on a VIC):

ASCII values (64, Plus/4, 16)

CTRL-E	CHR$(5)	white
CTRL-H	CHR$(8)	disable case change
CTRL-I	CHR$(9)	enable case change
CTRL-M	CHR$(13)	carriage return
CTRL-N	CHR$(14)	switch to lowercase
CTRL-Q	CHR$(17)	cursor down
CTRL-R	CHR$(18)	reverse on
CTRL-S	CHR$(19)	cursor home
CTRL-T	CHR$(20)	delete
CTRL-:	CHR$(27)	escape (Plus/4 and 16 only)

A few of these combinations are useful in programming. Others are not; why press two keys for delete when there's already a single key that does the same thing? The real advantage to using these equivalents comes when you need to send commands to your printer.

To print expanded characters, for example, you send a CHR$(14) to the printer. But first you must be in quote mode. So to print a wide hello, you would use OPEN4,4:PRINT#4,"**N** HELLO" (the **N** is a CTRL-N). If you're *not* in quote mode, something quite different will happen. The screen will suddenly switch to lowercase characters.

Printer Codes For Gemini

If you own a non-Commodore printer, check your manual for the various printer codes. With my particular setup, I use the following combinations:

ASCII Values (Gemini Printer)

CTRL-A	CHR$(1)	
CTRL-G	CHR$(7)	ring bell
CTRL-H	CHR$(8)	backspace
CTRL-I	CHR$(9)	printer tab
CTRL-J	CHR$(10)	line feed
CTRL-L	CHR$(12)	form feed
CTRL-N	CHR$(14)	expanded on
CTRL-O	CHR$(15)	expanded off
CTRL-R	CHR$(18)	reverse on
CTRL-T	CHR$(20)	compressed on
CTRL-:	CHR$(27)	escape

The most valuable of the above is escape, which prefaces dozens of additional Gemini commands.

Some interfaces may translate the numbers differently (some will switch 15 and 20, for example), depending on whether the DIP switches are set to emulate Commodore printers or to work transparently. It doesn't hurt to experiment. If your interface is set to emulate Commodore, some of the codes in the following table may also work.

Commodore Printers

The Commodore 1525 and MPS-801 are software-compatible printers. A program written for one

will work on the other. The 1526, however, is not completely compatible with other Commodore printers. For one thing, the 1526 lacks the built-in graphics commands of the 1525 and 801. It has a single custom character. To print in high-resolution, you must define the character, print it, define it again, print it, and so on.

The 1526 has its advantages, though: formatting commands (similar to PRINT USING), a paging feature (to skip over the perforations), and flexible line spacing.

Here are the Commodore printer codes (note that certain commands work only on certain printers):

ASCII Values (1525, MPS-801, 1526)

*	CTRL-H	CHR$(8)	set graphics mode
	CTRL-J	CHR$(10)	line feed
+	CTRL-L	CHR$(12)	form feed (new page)
	CTRL-N	CHR$(14)	enhanced/double-width on
	CTRL-O	CHR$(15)	enhance off
	CTRL-P	CHR$(16)	tab setting
	CTRL-Q	CHR$(17)	upper-/lowercase (cursor down mode)
	CTRL-R	CHR$(18)	reverse printing
+	CTRL-S	CHR$(19)	paging off
*	CTRL-Z	CHR$(26)	repeat graphics
*	CTRL-:	CHR$(27)	set graphics dot address

* *1525, MPS-801 only*
\+ *1526 only*

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If you wanted the printer to tab to column 39 and print an enhanced "The End" you would type:

```
OPEN4,4:PRINT#4,"P39NTHE END":PRINT#4:
  CLOSE4
```

Type the characters in bold with the CTRL key held down. The CTRL-P (followed by 39) performs a tab to the 39th position, and the CTRL-N sets enhanced mode. Experiment with these abbreviations, and you'll find it much easier to control the many features available.

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HORIZONS

Charles Brannon
Program Editor

SpeedScript 3.0, the latest revision of our popular all machine language word processor, premieres in the March 1985 issue of our sister publication COMPUTE!. The VIC-20 version will appear in April, to be followed in subsequent issues by an Atari and Apple version.

This new version significantly upgrades *SpeedScript*'s power and flexibility, yet retains compatibility with files created on earlier versions. We are indebted to you for your suggestions and criticisms, and many of the improvements were in response to your feedback.

The Blue Chip Printer

The low cost of the new Blue.Chip printer from Blue Chip Electronics, Inc., has attracted a lot of attention from GAZETTE readers. With most 80-column printers costing upwards of $250 to $300, Blue Chip Electronics has broken the $200 barrier, selling a full-featured printer for $189. The Blue Chip printer is not Commodore-specific; it can be used by any computer with a Centronics parallel printer interface. The VIC and 64 use their own proprietary serial interface, so you need a special interface module that converts Commodore's stream of bits into 8-bit chunks that are acceptable to the printer. Blue Chip sells a version of the Cardco Card/? G+ interface, customized for the Blue Chip printer, at $39.95. The Blue Chip printer can also be attached using most other Commodore parallel printer interfaces.

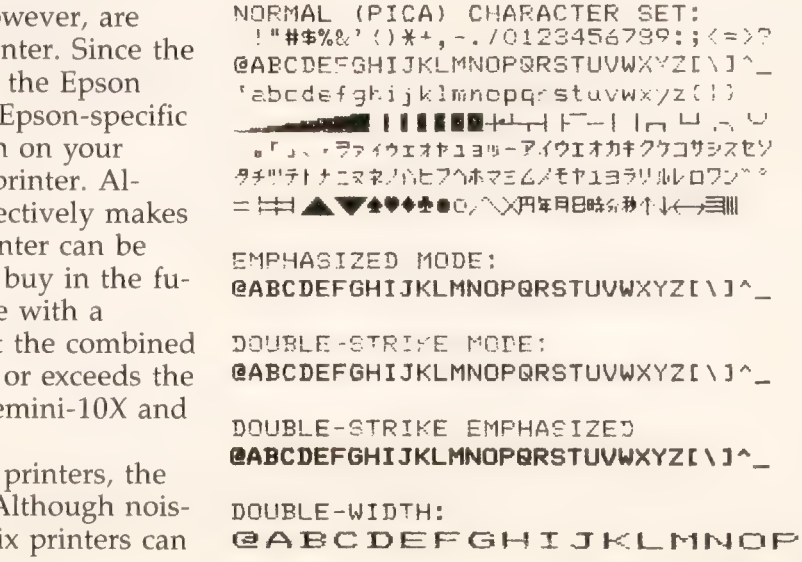
If you already have a Centronics parallel printer interface, chances are it will work with the Blue Chip. Some interfaces, however, are specific to a particular brand of printer. Since the Blue Chip is code-compatible with the Epson family of printers, you can use an Epson-specific interface or select the Epson option on your interface to make the most of the printer. Although the Blue Chip interface effectively makes the Blue Chip's price $228, the printer can be used with whatever computer you buy in the future, as long as it can communicate with a Centronics parallel printer. Even at the combined price of $228, this printer matches or exceeds the capabilities of the higher priced Gemini-10X and Epson MX-80.

Unlike some low-cost thermal printers, the Blue Chip is a dot-matrix printer. Although noisier than thermal printers, dot-matrix printers can print on any kind of paper and are generally faster. The Blue Chip printer can use either single sheet or fanfold paper by using either friction or tractor feed. Unlike many tractor feed units, the Blue Chip printer pushes the paper from behind the platen rather than pulling from in front. This can sometimes cause the paper to bunch up and tear loose from the tractor feed, and in day-to-day use I've suffered this problem periodically.

The Blue Chip printer uses a drop-in carbon film ribbon cartridge. Since there is no ink, there's no problem with messy fingers or smudges on the paper. Continuous cloth ribbons can be reused several times, but since a carbon film ribbon loses a bit of itself to paper when printed on, the second time the ribbon comes around, the print is significantly lighter. Carbon film gives a much sharper image, though. Incidentally, the Commodore 1526 printer uses the same ribbon cartridge.

Many Modes

This printer provides a plethora of printing modes and styles. Text can be printed in several sizes: pica (80 columns/line), elite (96 columns), condensed (142 columns), and double width (40 columns). Other printing modes include double strike, proportional spacing, true underlining and super/subscripts (see the accompanying figure for a sample of the character set and printing features). A removable panel on top of the printer gives access to 12 slide switches which let you customize the power-up state of the printer.



CONDENSED MODE
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'abcdefghijklmnopqrstuvwxyz{'}

DOUBLE-WIDTH CONDENSED
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'

ELITE CHARACTER SET
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_

ITALICS
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'

PROPORTIONAL SPACING
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_

MIXED MODES ON SAME LINE:
UNDERLINING DOUBLE STRIKE *ITALICS*
DOUBLE-WIDTH CONDENSED
SUPER AND SUB-SCRIPTS:
H_2C 2^{16}=65536
CONDENSED SUPERSCRIPT PRODUCES VERY FINE PRINT

GRAPHICS MODE: 640 DOTS/LINE

GRAPHICS MODE: 1280 DOTS/LINE

The standard character set is very readable. Since the printhead produces square instead of round dots, the gaps between printed dots are not as easily visible, a step closer to letter-quality. An emphasized mode prints more slowly, overlapping dots to give a very dark, solid image, but disables the use of some printing features. The text is formed from 9 vertical pins, giving true descenders for lowercase characters.

Also built into the standard character set is a set of Japanese Katakana characters (evidencing the printer's country of origin) and several graphics characters like those used on the VIC or 64. Several international fonts are supported, giving the special characters needed in foreign languages. One of the sets replaces the special characters with italics.

This printer offers several programmable features like horizontal tabulation, vertical forms control, left and right margins, reverse paper feed, form feed, automatic skip-over-perforation (used with fanfold paper), programmable line spacing, and true backspacing. You can even ring the printer's internal bell.

The graphics modes let you program from 640 to 1280 dots per line, which is up to four times the horizontal resolution of the 64. Unlike some printers, there is even a way to fire the ninth pin. You can print screen graphics with any software that supports the Epson family of printers.

Although no speed demon, the Blue Chip printer is fast, printing up to 100 characters per second in the normal printing mode. Almost all other printing modes are significantly slower, though.

The Blue Chip's Achilles heel is in the documentation, poorly translated from Japanese. We are advised to be sure the printer "is in working properly," and told how to "install the ribbon cartridge in the manner of followings," and informed that "all datas following this code are printed out in the characters of selected character set specified by n." It's a shame that such a good value in a printer is handicapped by its manual, but if all you care to do is list programs or print out unembellished text, you may never need most of the manual. It's even fairly simple to figure out how to install the paper, ribbon cartridge, and interface on your own. But if you want to use the richness of type styles and modes available, you'll be better off if you know something about programming. By the way, the example programs in the manual need a minor modification to the OPEN command to work on Commodore computers. However, the manual does include a handy quick-reference table of all the printer codes.

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Quick Character Transfer

Fabio Coronel

Setting up a custom character set can be painfully slow. This machine language routine will greatly speed up the process. For the VIC, 64, Plus/4, and 16.

Well-designed graphics can add a lot to almost any program. Sometimes pictures can communicate better than words. The easiest type of graphics to use is character graphics, those odd shapes shown on the front of the keys. Another type of graphics is achieved with redefined characters, which allow you to create shapes in much greater detail. But they're also more difficult to use.

First, you must reserve space for the new character set in RAM by lowering the top-of-BASIC pointer. Next, you change the character set pointer to point to the location of the new characters. You then transfer the character patterns from ROM to RAM and change selected characters to their new shapes.

The major drawback is the time it takes to transfer the character patterns. It may take BASIC almost a minute to PEEK the bytes from ROM and POKE them to RAM, depending on the number of characters transferred.

"Quick Character Transfer" creates a machine language routine to instantly transfer the character patterns from ROM to RAM. The ML routine is POKEd into the cassette buffer, but it's completely relocatable. You can put it elsewhere by setting variable AD in line 100 to the start of the new location.

Adding It To Your Programs

To use Quick Character Transfer, it must be added to your program. It can be placed at the end as a subroutine, or at the start as part of the initialization as long as it's executed before you redefine your characters. You may have to change the line numbers to make it fit.

It can also be used by itself as a demonstration. Type in the appropriate version for your computer and save it before running. The characters on the screen will momentarily appear as a random pattern of dots as the pointer to the start of the character set is changed to point to the random bytes in RAM. Then the characters quickly return to normal as the patterns in ROM are transferred to RAM.

Now you can change any character to look like a spaceship or a bird or a foreign language letter. Just POKE the character pattern into the RAM area used by the new character set. To show that the characters are indeed in RAM, lines 1000–1010 change the @ character into a happy face. Type the @ key to see it. To return to the normal character set, press RUN/STOP–RESTORE (RUN/STOP–RESET on the Plus/4 and 16).

The 64 Version

The 64 version transfers the entire uppercase/graphics character set (256 characters) from ROM to RAM. You can transfer the uppercase/lowercase character set instead by changing the 208 to 216 in line 170 (thus altering the checksum in line 120). The location of the character set in RAM is determined by the two 14s in line 90. These values represent the number of Kbytes from the start of the video bank.

When selecting a place for the character set on the 64, remember that it must be placed above your BASIC program on a 2K boundary in the same video bank as the screen. If you were frightened by that last sentence, just leave the values at 14. This puts the start of the character set at 14336, leaving 12K free for your BASIC program.

The VIC Version

The VIC version transfers the first 64 characters from ROM to the location specified by the POKE to 36869. POKEing 255 here puts the start of the

character set at 7168, room enough for 64 characters. You must also protect the characters from BASIC by POKEing 7168/256 = 28 into location 56 as in line 90. You'll have 3K left for your program.

If 64 characters aren't enough, just change line 90 to:

```
90 POKE56,24:CLR:POKE36869,254
```

Also, change the 2 to 6 in line 190. This gives you 192 characters starting at 6144, leaving 2K free for your program.

The value in line 160 determines which characters will be transferred from ROM. A value of 128 transfers the uppercase characters, 132 transfers reverse uppercase, 136 gives lowercase, and 140 gives reverse lowercase. If you make these changes, don't forget to also change the checksum in line 120. Or you can simply delete this line once you've saved a working copy of the program.

The Plus/4 And 16 Version

The Plus/4 and 16 version transfers the uppercase character set to the location specified by the high byte in lines 90, 150, and 220. To transfer the lowercase set, change the 208 to 212 in line 160.

See listings on page 137.

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COMPUTE!'s Gazette, October 1984

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Baker's Dozen
Part 3

Lawrence Cotton

In this final installment, we'll see four more programs for the 64 which offer some interesting techniques—and results.

If you've been following this series, you'll recall that most of the programs we've seen include routines and techniques which may be used interchangeably with each other. If you're new to programming sound and graphics on the 64, you might study the listings—they're short and contain ideas you can use in your own programs.

Mondrian

This program, only seven lines, is a good example of how much we can get for as little typing as possible. Let's look at each of the lines:

Line 10 clears the screen (CHR($147)), prints white (CHR$(5)), and changes the border and background colors (53280 and 53281) to black. In line 20, R is the amount to be added to screen memory locations, and A is an increment of 1.

Lines 30 and 40 choose random sizes of blocks to be "painted." Both color and starting screen location are determined here. The maximum block size is ten by ten characters (line 30). Try your own dimensions here.

Lines 50 and 60 ensure that the block to be painted will appear on the screen; if not, another block size is selected.

Line 70 is where the blocks are painted; a loop within a loop paints a block of size N characters (reversed spaces) by P characters, in color Q, starting at location V. It then loops back to pick another block size, color, and starting location.

Rectangles

Another short program, "Rectangles" draws random size rectangles in random colors. They start at random locations, and are superimposed on each other. Here's the way the program works.

Line 5 defines increments, rectangle size, and the value added to screen memory locations to POKE a color (Q in line 20).

Line 10 clears the screen and changes border and background colors to black (as in line 10 of "Mondrian").

Lines 20 and 30 choose random screen locations, and color and rectangle dimensions (N by Z). Lines 40–75 check to be sure the rectangle is drawn on the screen.

The rectangles are created in lines 80–150.

Line 160 loops back to choose another size, color, and location.

Magix

Program 3, another short program, is fairly straightforward in programming technique and in execution. The key to the program is the subroutine beginning at line 200. This subroutine is what performs the hard work in the program. It paints a square block with a random color and increments it diagonally four times in four locations.

Lines 10, 40, 70, and 100 modify the values plugged into the subroutine, redefine starting positions, and choose another color.

Lines 30, 60, 90, and 120 erase unnecessary blocks by POKEing a space (32) to the appropriate locations.

Noodle Doodle

Probably the most interesting of the programs this month, "Noodle Doodle" integrates sound

and graphics. It doodles endlessly (press RUN/STOP–RESTORE to exit), in color, to the accompaniment of a double tone (two voices) synchronized with the doodle. If the doodle's random direction goes up or right, the tones climb; if it goes left or down, the tones lower. The effect is strange and hypnotic.

Let's see how the program works.

Lines 10–30 set up the screen, clear the sound chip, and set up parameters for musical voices one and two.

Variables are assigned in line 40: F increments the frequencies up or down, depending on the movement of the doodle as described earlier; G is a multiplier for voice two's frequency (G times voice one's); L is the low-byte value of the frequency POKEd into locations Z and ZZ; H and I are the high-byte starting values for frequencies POKEd into locations Y and YY; Z, Y, ZZ, and YY are the low and high locations for voices one and two, respectively; V is the screen location where the doodle starts, and C is the value added to the screen location to color a character.

Lines 100, 200, 300, 400, 500, 600, 700, and 800 generate a random number from 0 to 5 (controlling the length of the doodled line segments) and choose a random color (1–15). *Note: These lines can be entered by typing line 100, then typing a 2, 3, 4, 5, 6, 7, or 8 over the 1 in 100 (press RETURN each time).*

Lines 105, 205, 305, 405, 505, 605, 705, and 805 do most of the doodling by POKEing the horizontal and vertical lines (67 and 66) and their colors to the screen.

Lines 108, 208, 308, 408, 508, 608, 708, and 808 increment screen location V, and POKE frequencies H, I, and L to control the pitch of tones and increment them by F. Changing the value of F in line 40 can create some interesting effects.

Lines 110, 210, 310, 410, 510, 610, 710, and 810 check to make sure legal frequency values are POKEd into Y, Z, YY, and ZZ.

Last, lines 120, 220, 320, 420, 520, 620, 720, and 820 POKE the corners which connect the horizontal and vertical lines. A random number (X) is chosen (either 1 or 2) to determine which way the doodle is to go next. This is dependent on the the direction it came from and which corner was POKEd.

In all the programs of "Baker's Dozen," values can be changed to create different effects. Feel free to experiment. The real merit of this series, however, is in offering some effective techniques which don't require a lot of programming time or space.

See listings on page 123.

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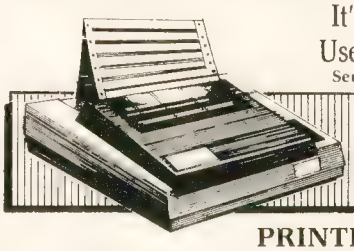

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Disk Directory Sort

N. A. Marshall

This short program can help you better organize your disks by alphabetically sorting each of your disk directories. For the VIC, 64, Plus/4, and Commodore 16.

An alphabetized disk directory can be a timesaver, especially if you have a variety of disks. It's particularly helpful when you're looking for a filename in a long directory.

"Disk Directory Sort" is a short (35-line) BASIC program that works on the VIC (with or without expansion—see below for details), 64, Plus/4, or Commodore 16. Operation is simple. Load "Disk Directory Sort",8. Then insert the disk you wish to alphabetically sort. Type RUN, and the directory is read into memory and sorted. You see the sort happening on screen. Note that all deleted files are written to the end of the sort. After all files have been sorted, you're prompted to press the space bar to write the newly sorted directory (still sorted only in memory) back to disk. If you change your mind at this point, remove the disk before pressing the space bar. No damage is done, and your original directory remains intact.

A word of caution: The program reads the directory, alphabetizes it, and writes it back to disk. If you make any typing mistakes while entering it, the program could ruin the directories on your disks. There's a chance you would lose some programs. After entering and saving it, you should test it on an unimportant disk, in case you incorrectly typed a line.

The program works on any size directory (up to 144 filenames are allowed on 1540/1541 disk drives). Here's a brief summary of the program routines:

Lines	Description
20–140	the sort
150–210	read in the file entries
220–290	write the directory
300–310	process the directory header
320–330	read a block
340–350	initialize the program

Notes To VIC Users

If you're using an unexpanded VIC, change the value of X to 45 in line 340. A maximum of 45 filenames (including deleted filenames) is allowed. With 3K expansion, change X to 115. With 8K or more, no modification is necessary—up to 144 filenames can be sorted.

See listing on page 127.

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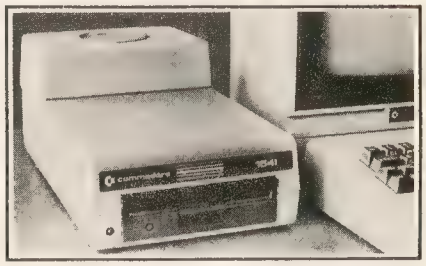

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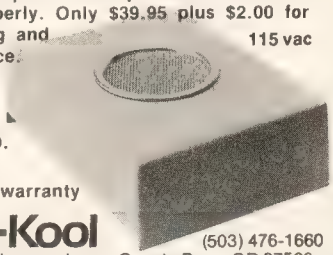

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Disk Handler

B. R. Carson

Are you curious about how your 1541 disk drive stores information on disk? This program helps you examine—and change—individual bytes on a disk. For the 64 or VIC with at least 3K expansion. Requires "Display T&S" program from the Test/Demo Disk packaged with the 1541.

Engineers and mathematicians use the term "black box" to describe a machine you can't open up and look inside. You don't talk about what it's made of or what parts are inside. It's explained according to its function—something goes in and something else comes out.

There are a lot of black boxes around. To use a television, you have to know how to turn it on and tune in a channel. You don't need to know about transistors and circuits, however. And a lot of people drive automobiles without knowing the first thing about pistons and carburetors.

Some computer owners treat their disk drive as a black box. They use it to save and load programs, never wondering how it works or why.

Delving Into Tracks And Sectors

If you're interested in how information goes onto the disk, load "Display T&S" from the Test/Demo Disk you received with the disk drive. Before you type RUN, insert a disk into the drive (or use the Test/Demo Disk). When the program asks for track and sector, answer 18 and 1, which is where the disk directory begins.

You should see a lot of hexadecimal numbers, along with the CHR$ characters represented by some of the numbers. You'll also see the names of the programs on the disk.

In Appendix D of the 1541 User's Manual (also packaged with the disk drive) is an explanation of what some of those numbers mean. If you're interested in learning more about how the drive works, there are several good reference books. Or see "Disk Tricks" (September 1984 GAZETTE).

Using Disk Handler

"Disk Handler" is a utility that must be appended to the Display T&S program (see the instructions below before you start typing it in).

It extends the value of Display T&S by allowing you not only to read the bytes from disk, but also write new bytes to the disk. It adds three new commands: Change, Rewrite, and End.

After appending Disk Handler and running it, you'll see 16 lines of four bytes each, a total of 64 bytes. Since each sector contains 256 bytes, it will take four screens to cover a sector.

Near the bottom of the screen will be four prompts:

```
CONTINUE (Y/N)
CHANGE (C)
REWRITE (W)
END (E)
```

To go to the next 64-byte section, type Y. If you type N, you'll return to the main menu.

The Change option allows you to change a byte on the disk. Enter the letter C and you'll be asked for a starting point. Type the number of the first byte you want to change (in hexadecimal, as it appears on the screen).

The changes will not be made directly to the disk (in case you change your mind later). They are written to a buffer inside the drive.

Let's say the byte you want to change contains a 64 (hex $40). You enter the location and the program responds:

```
40-
```

You can now do one of three things:

1. Press RETURN to end the change routine and return to the four prompts.

2. Type a new value (in hex), to replace the current value. The next byte will then be printed,

so you can change more than one byte at a time.

3. Press the comma key if you want to leave the value as is.

If you make a mistake, press RETURN and select the change option again (remember the change is not permanent yet).

Once you're satisfied with the changes, choose the rewrite option. This copies the information from the memory buffer onto the disk.

The final choice, End, allows you to exit the program. This feature is lacking from the original Display T&S program.

Entering The Program

Disk Handler will not work by itself; it's designed to be appended to Display T&S.

First, load Display T&S from the Test/Demo Disk. With that program in memory, type in Disk Handler and save it to one of your own disks.

I recommend that you first experiment with an unimportant disk in case you've made a typing mistake.

I've used Disk Handler for patching up scrambled disk directories, correcting errors in sequential files, and salvaging scratched programs. But note: *This is not a program for novices.* If you aren't careful, this program can do a lot of harm to programs and files.

See listing on page 128.

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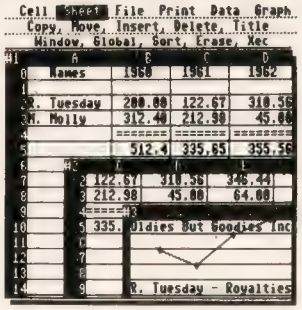

Actual screen dump taken by VIZASTAR

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NEWS & PRODUCTS

64 Draw Poker Game

Silicon Slick's Lowball Draw Poker, a game, instructor, and analysis tool for the Commodore 64, has been released by Snake River Software.

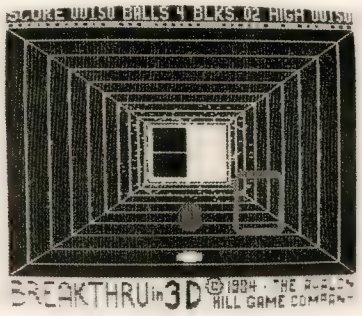
The program teaches the user to play California-style lowball draw poker using a game simulation. As a tutorial, the program comments on all facets of play, including before and after draw betting and drawing cards. Game options include ante size, before and after draw betting limits, size and number of blind bets, and skill level and number of opponents.

The game retails for $34.95.

Snake River Software
2100 Belmont Avenue
Idaho Falls, ID 83401
(208) 524-5464
Circle Reader Service Number 210.

64 Arcade, Strategy, Adventure Games

Among a number of games recently introduced by Microcomputer Games, Inc., a division of the Avalon Hill Game Co., are: *Fortress of the Witch King*, an adventure game; *London Blitz*, a World War II simulation in which you must defuse a series of bombs; and *Breakthru*, a three-dimensional arcade-style racquetball game.



A three-dimensional racquetball game screen from Breakthru, *one of the new games for the Commodore 64 from Microcomputer Games, Inc.*

Suggested retail prices are $25 each on disk. *Breakthru* and *London Blitz* are also available on cassette for $20 each.

Microcomputer Games, Inc.
The Avalon Hill Game Co.
4517 Harford Road
Baltimore, MD 21214
(301) 254-9200
Circle Reader Service Number 211.

Cassette Storage For 64, VIC-20

Entrepo, Inc. has introduced the Quick Cassette storage system for Commodore 64 and VIC-20 computers.

The drive is designed as a replacement for audio cassette storage systems. It plugs into the cassette port on Commodore computers, and can reportedly read data from the tape into the computer 15 times faster than an audio cassette.

The Quick Cassette has a slow speed read mode that emulates an audio cassette, and is fully compatible with Commodore BASIC and audio cassette commands. It also features a connector allowing programs to be copied from either a Commodore cassette or another Quick Cassette. A file management utility also is included.

Suggested retail price is around $85.

Entrepo Inc.
1294 Lawrence Station Road
Sunnyvale, CA 94086
(408) 734-3133
Circle Reader Service Number 212.

Strategy, Adventure, Sports Games

Strategic Simulations, Inc. has introduced a number of new games for the Commodore 64: *Broadsides*, a naval battle simulation set during the Napoleonic era; *President Elect*, an election simulation; *Computer Quarterback*, a football simulation; and *Breakthrough in the Ardennes*, a simulation of World War II's Battle of the Bulge.

Each of the games retails for $39.95, except *Breakthrough in the Ardennes*, which has a

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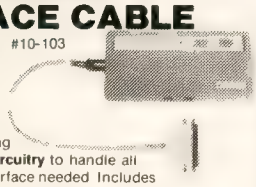

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The popular board game *Scrabble* has been converted into a computer game called *Monty Plays Scrabble* for the Commodore 64 by Epyx Computer Software.

Play can be either against the computer or against up to three human opponents. There are four skill levels, and a playing vocabulary of more than 12,000 words.

Suggested retail price is about $30.

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64 Home Control System

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Progressive Peripherals & Software has introduced *The Professor,* a two-disk tutorial for the Commodore 64.

The disks explain the machine's graphics and sound capabilities, and provide instructions to the features of the Commodore 64, as well as an introduction to BASIC programming. A tutorial on the keyboard is also included.

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2186 South Holly, Suite #2
Denver, CO 80222
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Circle Reader Service Number 216.

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Bug-Swatter:
Modifications And Corrections

• Readers who typed in "3-D Labyrinth" (December 1984) may have discovered that corridors leading to the right did not look like the left corridors. To fix this glitch, insert a space in line 54, just after {3 DOWN}. Also insert a space in line 57, just after {7 DOWN}.

• Music Patterns, Program 1 from "Baker's Dozen: Part 2" (February), contains a bug that occasionally causes POKEs outside of screen memory. These POKEs to the BASIC program area will garble the program and cause it to crash. Change line 20 as follows:

```
20 K=INT(959*RND(0))+1024:B=160:C=54272
```

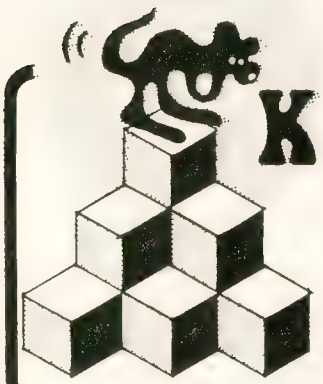
• In "VIC/64 Assembler" from the November 1984 "Machine Language For Beginners" column, it's necessary to change the 256 to a 255 in line 2005, because POKEs to memory must be within the range 0–255. If you try to enter an instruction such as LDA #256, the program stops with an ILLEGAL QUANTITY ERROR.

• Line 250 of "Supertank" (November 1984) was listed correctly, but not printed correctly. The fourth statement should be POKEV+3,X1. In some copies of the November issue, the bottom corner of the 1 was cut off, making it look like a right bracket.

We appreciate receiving both corrections and suggested modifications from readers. Address them to:

Bug-Swatter
c/o COMPUTE!'s GAZETTE
P.O. Box 5406
Greensboro, NC 27403

Please indicate the type of error you have found, as well as the line number.



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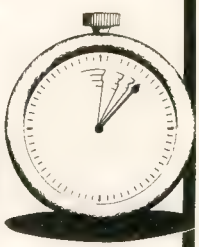

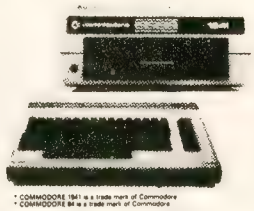

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How To Type In *COMPUTE!'s GAZETTE* Programs

Each month, COMPUTE!'s GAZETTE publishes programs for the VIC-20, Commodore 64, Plus/4, and 16. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. Also, carefully read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We publish two programs, which appear periodically, designed to make your typing effort easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then back on, erasing whatever was in memory. So be sure to *save a copy of your program before you run it*. If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 spaces} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A means hold down the the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A}), type the key as many times as indicated (in our example; enter eight SHIFTed A's). To type {SHIFT-SPACE}, hold down the SHIFT key and press the space bar.

If a key is enclosed in special brackets, ⟦ ⟧, hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT}, and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode*.

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT + CLR/HOME	
{HOME}	CLR HOME	
{UP}	SHIFT + CRSR ↕	
{DOWN}	CRSR ↕	
{LEFT}	SHIFT + CRSR ↔	
{RIGHT}	CRSR ↔	
{RVS}	CTRL + 9	
{OFF}	CTRL + 0	
{BLK}	CTRL + 1	
{WHT}	CTRL + 2	
{RED}	CTRL + 3	
{CYN}	CTRL + 4	

When You Read:	Press:	See:
{PUR}	CTRL + 5	
{GRN}	CTRL + 6	
{BLU}	CTRL + 7	
{YEL}	CTRL + 8	
{F1}	f1	
{F2}	SHIFT + f1	
{F3}	f3	
{F4}	SHIFT + f3	
{F5}	f5	
{F6}	SHIFT + f5	
{F7}	f7	
{F8}	SHIFT + f7	

When You Read:	Press:	See:
←	←	
↑	SHIFT + ↑	

For Commodore 64 Only

When You Read:	Press:	See:
⟦1⟧	C= + 1	
⟦2⟧	C= + 2	
⟦3⟧	C= + 3	
⟦4⟧	C= + 4	
⟦5⟧	C= + 5	
⟦6⟧	C= + 6	
⟦7⟧	C= + 7	
⟦8⟧	C= + 8	

MLX Machine Language Entry Program

For Commodore 64 And VIC-20

Charles Brannon, Program Editor

MLX is a labor-saving utility that allows almost fail-safe entry of machine language programs published in GAZETTE. You need to know nothing about machine language to use MLX—it was designed for everyone. There are separate versions for the Commodore 64 and expanded VIC-20 (at least 8K).

MLX is a new way to enter long machine language (ML) programs with a minimum of fuss. MLX lets you enter the numbers from a special list that looks similar to BASIC DATA statements. It checks your typing on a line-by-line basis. It won't let you enter illegal characters when you should be typing numbers. It won't let you enter numbers greater than 255 (forbidden in ML). It won't let you enter the wrong numbers on the wrong line. In addition, MLX creates a ready-to-use tape or disk file. You can then use the LOAD command to read the program into the computer, as with any program:

LOAD "filename",1,1 (for tape)
LOAD "filename",8,1 (for disk)

To start the program, you enter a SYS command that transfers control from BASIC to machine language. The starting SYS number always appears in the appropriate article.

Using MLX

Type in and save MLX (you'll want to use it in the future). When you're ready to type in an ML program, run MLX. MLX asks you for two numbers: the starting address and the ending address. These numbers are given in the article accompanying the ML program.

You'll see a prompt corresponding to the starting address. The prompt is the current line you are entering from the listing. It increases by six each time you enter a line. That's because each line has seven numbers—six actual data numbers plus a *checksum number*. The checksum verifies that you typed the previous six numbers correctly. If you enter any of the six numbers wrong, or enter the checksum wrong, the computer rings a buzzer and prompts you to reenter the line. If you enter it correctly, a bell tone sounds and you continue to the next line.

MLX accepts only numbers as input. If you make a typing error, press the INST/DEL key; the entire number is deleted. You can press it as many times as necessary back to the start of the line. If you enter three-digit numbers as listed, the computer automatically prints the comma and goes on to accept the next number. If you enter less than three digits, you can press either the SPACE bar or RETURN key to advance to the next number. The checksum automatically appears in inverse video for emphasis.

To simplify your typing, MLX redefines part of the keyboard as a numeric keypad:

```
  U I O              7 8 9
H J K L  become  0    4 5 6
  M , .              1 2 3
```

MLX Commands

When you finish typing an ML listing (assuming you type it all in one session) you can then save the completed program on tape or disk. Follow the screen instructions. If you get any errors while saving, you probably have a bad disk, or the disk is full, or you've made a typo when entering the MLX program itself.

You don't have to enter the whole ML program in one sitting. MLX lets you enter as much as you want, save it, and then reload the file from tape or disk later.

MLX recognizes these commands:

SHIFT-S: Save **SHIFT-N: New Address**
SHIFT-S: Load **SHIFT-D: Display**

When you enter a command, MLX jumps out of the line you've been typing, so we recommend you do it at a new prompt. Use the Save command to save what you've been working on. It will save on tape or disk, as if you've finished, but the tape or disk won't work, of course, until you finish the typing. Remember what address you stop at. The next time you run MLX, answer all the prompts as you did before, then insert the disk or tape. When you get to the entry prompt, press SHIFT-L to reload the partly completed file into memory. Then use the New Address command to resume typing.

To use the New Address command, press SHIFT-N and enter the address where you previously stopped. The prompt will change, and you can then continue typing. Always enter a New Address that matches up with one of the line numbers in the special listing, or else the checksum won't work. The Display command lets you display a section of your typing. After you press SHIFT-D, enter two addresses within the line number range of the listing. You can abort the listing by pressing any key.

What if you forgot where you stopped typing? Use the Display command to scan memory from the beginning to the end of the program. When you reach the end of your typing, the lines will contain a random pattern of numbers. When you see the end of your typing, press any key to stop the listing. Use the New Address command to continue typing from the proper location.

See listings on page 129.

Baker's Dozen

(Article on page 111.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Mondrian

```
10 PRINTCHR$(147)CHR$(5):POKE53280,0:POKE
   53281,0                          :rem 242
20 R=54272:A=1                      :rem 222
30 N=INT(10*RND(1))+1:P=INT(10*RND(1))+1:
   Q=INT(15*RND(1))+1               :rem 29
40 V=INT(1000*RND(1))+1024          :rem 118
50 IFV+N>2023THENV=V-N:GOTO20       :rem 48
60 IFV+(40*P)>2023THENV=V-(40*P):GOTO20
                                    :rem 243
70 FORZ=1TOP:FORX=1TON:POKEV+A,160:POKEV+
   A+R,Q:V=V+A:NEXT:V=V+40-N:NEXTZ:GOTO30
                                    :rem 210
```

Program 2: Rectangles

```
5 A=1:B=-1:C=40:D=-40:E=10:P=54272:rem 77
10 PRINTCHR$(147):POKE53280,0:POKE53281,0
                                    :rem 107
20 V=INT(1000*RND(1))+1024::Q=INT(15*RND(
   1))+1                            :rem 4
30 N=INT(E*RND(1))+1:Z=INT(E*RND(1))+1
                                    :rem 153
40 IFV+N<1024THEN:V=V-N:GOTO20      :rem 103
45 IFV+N>2023THEN:V=V-N:GOTO20      :rem 110
50 IFV-N<1024THEN:V=V+N:GOTO20      :rem 104
55 IFV-N>2023THEN:V=V+N:GOTO20      :rem 111
60 IFV+(40*Z)<1024THEN:V=V-(40*Z):GOTO20
                                    :rem 63
65 IFV+(40*Z)>2023THEN:V=V-(40*Z):GOTO20
                                    :rem 70
70 IFV-(40*Z)<1024THEN:V=V+(40*Z):GOTO20
                                    :rem 64
75 IFV-(40*O)>2023THEN:V=V+(40*Z):GOTO20
                                    :rem 60
80 FORX=1TON:POKEV+A,67:POKEV+A+P,Q:V=V+A
   :NEXT                            :rem 245
90 POKEV,75:POKEV+P,Q               :rem 61
100 FORX=1TOZ:POKEV+D,66:POKEV+D+P,Q:V=V+
    D:NEXT                          :rem 50
110 POKEV,73:POKEV+P,Q              :rem 100
120 FORX=1TON:POKEV+B,67:POKEV+B+P,Q:V=V+
    B:NEXT                          :rem 35
130 POKEV,85:POKEV+P,Q              :rem 105
140 FORX=1TOZ:POKEV+C,66:POKEV+C+P,Q:V=V+
    C:NEXT                          :rem 51
150 POKEV,74:POKEV+P,Q              :rem 105
160 GOTO20                          :rem 50
```

Program 3: Magix

```
5 PRINTCHR$(147)CHR$(5):POKE53280,0:POKE5
  3281,0                            :rem 198
10 V=1873:A=1:B=-40:C=-1:D=40:Q=160:R=INT
   (15*RND(1))+1:S=54272            :rem 181
20 GOSUB200                         :rem 116
30 POKE1093,32                      :rem 240
40 V=1215:A=-1:B=40:C=1:D=-40:R=INT(15*RN
   D(1))+1                          :rem 129
50 GOSUB200                         :rem 119
60 POKE1995,32                      :rem 254
70 V=1893:A=-1:B=-40:C=1:D=40:R=INT(15*RN
   D(1))+1                          :rem 144
80 GOSUB200                         :rem 122
90 POKE1073,32                      :rem 244
100 V=1191:A=1:B=40:C=-1:D=-40:R=INT(15*R
    ND(1))+1                        :rem 177
110 GOSUB200                        :rem 164
120 POKE2011,32                     :rem 23
130 FORT=1TO1000:NEXT:GOTO5         :rem 194
200 FORP=1TO10:POKEV,Q:POKEV+S,R    :rem 50
210 N=1:FORX=1TON:POKEV+A,Q:POKEV+S,R:V=V
    +A:NEXT                         :rem 146
220 FORX=1TON:POKEV+B,Q:POKEV+S,R:V=V+B:N
    EXT                             :rem 159
230 N=N+1:FORX=1TON:POKEV+C,Q:POKEV+S,R:V
    =V+C:NEXT                       :rem 17
240 FORX=1TON:POKEV+D,Q:POKEV+S,R:V=V+D:N
    EXT                             :rem 165
250 N=N+1:FORX=1TON:POKEV+A,Q:POKEV+S,R:V
    =V+A:NEXT                       :rem 15
260 FORX=1TON:POKEV+B,Q:POKEV+S,R:V=V+B:N
    EXT                             :rem 163
270 NEXTP                           :rem 40
280 RETURN                          :rem 122
```

Program 4: Noodle Doodle

```
10 PRINTCHR$(147)CHR$(28):POKE53280,1:POK
   E53281,1                         :rem 41
20 FORL=54272TO54295:POKEL,0:NEXT:POKE542
   96,15                            :rem 17
25 POKE54277,190:POKE54278,255:POKE54282,
   190                              :rem 212
30 POKE54285,255:POKE54276,65:POKE54283,6
   5:POKE54275,8:POKE54282,8        :rem 22
40 F=1:G=1.5:L=10:H=10:I=H*G:Z=54272:Y=54
   273:ZZ=54279:YY=54280:V=1398:C=54272
                                    :rem 147
50 FORQ=1TO9:PRINT:NEXT:PRINTTAB(9)"PLEAS
   E TURN UP VOLUME"                :rem 19
55 PRINT:PRINTTAB(5)"HIT RUN/STOP-RESTORE
    TO STOP"                        :rem 232
60 FORT=1TO2000:NEXT:PRINTCHR$(147)
                                    :rem 162
100 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                    :rem 86
105 FORN=1TOA:POKEV,67:POKEV+C,B    :rem 16
108 V=V+1:POKEY,H:POKEZ,L:POKEYY,I:POKEZZ
    ,L:H=H+F:I=I+F:NEXT             :rem 223
110 IFH>243THENH=10:I=H*G           :rem 206
120 POKEV,73:POKEV+C,B:V=V+40:X=INT(2*RND
    (1))+1:ONXGOTO700,800           :rem 231
200 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                    :rem 87
205 FORN=1TOA:POKEV,67:POKEV+C,B    :rem 17
208 V=V+1:POKEY,H:POKEZ,L:POKEYY,I:POKEZZ
    ,L:H=H+F:I=I+F:NEXT             :rem 224
210 IFH>243THENH=10:I=H*G           :rem 207
220 POKEV,75:POKEV+C,B:V=V-40:X=INT(2*RND
    (1))+1:ONXGOTO500,600           :rem 232
300 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                    :rem 88
305 FORN=1TOA:POKEV,67:POKEV+C,B    :rem 18
308 V=V-1:POKEY,H:POKEZ,L:POKEYY,I:POKEZZ
    ,L:H=H-F:I=I-F:NEXT             :rem 231
310 IFH<12THENH=10:I=H*G            :rem 152
320 POKEV,85:POKEV+C,B:V=V+40:X=INT(2*RND
```

```
    (1))+1:ONXGOTO700,800          :rem 236
400 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                   :rem 89
405 FORN=1TOA:POKEV,67:POKEV+C,B   :rem 19
408 V=V-1:POKEY,H:POKEZ,L:POKEYY,I:POKEZZ
    ,L:H=H-F:I=I-F:NEXT            :rem 232
410 IFH<12THENH=10:I=H*G           :rem 153
420 POKEV,74:POKEV+C,B:V=V-40:X=INT(2*RND
    (1))+1:ONXGOTO500,600          :rem 233
500 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                   :rem 90
505 FORN=1TOA:POKEV,66:POKEV+C,B   :rem 19
508 V=V-40:POKEY,H:POKEZ,L:POKEYY,I:POKEZ
    Z,L:H=H+F:I=I+F:NEXT           :rem 24
510 IFH>243THENH=10:I=H*G          :rem 210
515 POKEV,73:POKEV+C,B:V=V-1:IFV<1384THEN
    300                            :rem 191
520 X=INT(2*RND(1))+1:ONXGOTO300,400
                                   :rem 65
600 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                   :rem 91
605 FORN=1TOA:POKEV,66:POKEV+C,B   :rem 20
608 V=V-40:POKEY,H:POKEZ,L:POKEYY,I:POKEZ
    Z,L:H=H+F:I=I+F:NEXT           :rem 25
610 IFH>243THENH=10:I=H*G          :rem 211
615 POKEV,85:POKEV+C,B:V=V+1:IFV<1384THEN
    100                            :rem 191
620 X=INT(2*RND(1))+1:ONXGOTO100,200
                                   :rem 62
700 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                   :rem 92
705 FORN=1TOA:POKEV,66:POKEV+C,B   :rem 21
708 V=V+40:POKEY,H:POKEZ,L:POKEYY,I:POKEZ
    Z,L:H=H-F:I=I-F:NEXT           :rem 28
710 IFH<12THENH=10:I=H*G           :rem 156
715 POKEV,75:POKEV+C,B:V=V-1:IFV>1683THEN
    400                            :rem 200
720 X=INT(2*RND(1))+1:ONXGOTO300,400
                                   :rem 67
800 A=INT(5*RND(1)):B=INT(13*RND(1))+2
                                   :rem 93
805 FORN=1TOA:POKEV,66:POKEV+C,B   :rem 22
808 V=V+40:POKEY,H:POKEZ,L:POKEYY,I:POKEZ
    Z,L:H=H-F:I=I-F:NEXT           :rem 29
810 IFH<12THENH=10:I=H*G           :rem 157
815 POKEV,74:POKEV+C,B:V=V+1:IFV>1683THEN
    200                            :rem 196
820 X=INT(2*RND(1))+1:ONXGOTO100,200
                                   :rem 64
```

AVAIL

(Article on page 74.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Note: The checksums (rems) in the program below are for use with "The Automatic Proofreader—VIC and 64 only.)

```
1 A=40:REM ON VIC, SET A=22 COLUMNS
                                   :rem 203
5 PRINT"{CLR}{9 DOWN}"TAB((A-8)/2)"{RVS}A
  VAIL":FORI=1TO2000:NEXT          :rem 43
10 DIMW$(20),X$(20),IN$(20):PRINT"{CLR}"
                                   :rem 252
20 PRINT:PRINT"?:";:GOSUB30:IN$=B$:B$="":
   GOTO60:REM MAIN PROGRAM STARTS @ 20
                                   :rem 59
30 GETC$:PRINTC$;:IFC$=CHR$(13)THENRETURN
                                   :rem 69
40 IFC$=CHR$(20)THENB$=LEFT$(B$,LEN(B$)-1
   ):GOTO30                        :rem 25
50 B$=B$+C$:GOTO30                 :rem 214
60 L=LEN(IN$):P=1:W=1              :rem 209
70 FORI=1TOL:IFMID$(IN$,I,1)=" "THENGOSUB
   200                             :rem 91
80 NEXT                            :rem 167
90 W$(W)=MID$(IN$,P)               :rem 79
100 E$=RIGHT$(W$(W),1):IFE$="."ORE$="?"OR
    E$="!"THEN120                  :rem 195
110 GOTO130                        :rem 95
120 W$(W)=LEFT$(W$(W),LEN(W$(W))-1)
                                   :rem 147
130 FORJ=1TOW:X$(J)=W$(J):NEXT     :rem 74
140 GOSUB210                       :rem 168
150 PRINT" OK?";                   :rem 123
160 GETOK$:IFOK$=""THEN160           :rem 3
170 IFOK$="N"THENGOSUB410          :rem 248
180 J=W:IN$(C)=IN$:C=C+1:IFC>19THENC=0
                                   :rem 228
190 IN$="":GOTO20                  :rem 171
200 W$(W)=MID$(IN$,P,I-P):P=I:W=W+1:RETUR
    N                               :rem 21
210 PRINT:PRINT:FORI=1TOW          :rem 185
220 IFX$(I)="WAS"ORX$(I)=" WAS"THENW$(I)=
    " WERE"                        :rem 192
230 IFX$(I)="I"ORX$(I)=" I"ORX$(I)=" ME"O
    RLEFT$(X$(I),2)="I'"THENW$(I)=" YOU"
                                   :rem 183
240 IFX$(I)=" WERE"THENW$(I)=" WAS"
                                   :rem 159
250 IFX$(I)=" MY"THENW$(I)=" YOUR"
                                   :rem 119
260 IFX$(I)=" AM"THENW$(I)=" ARE":rem 233
270 IFX$(I)="YOU"ORX$(I)=" YOU"THENW$(I)=
    " I"                           :rem 255
280 IFX$(I)="YOU'RE"ORX$(I)=" YOU'RE"THEN
    W$(I)=" I'M"                   :rem 240
290 IFX$(I)="YOUR"ORX$(I)=" YOUR"THENW$(I
    )=" MY"                          :rem 2
300 IFRIGHT$(X$(I),2)="'S"THENW$(I)=LEFT$
    (X$(I),LEN(X$(I))-2)+" IS"     :rem 151
310 IFRIGHT$(X$(I),3)="I'M"THENW$(I)=LEFT
    $(X$(I),LEN(X$(I))-3)+"YOU ARE"
                                   :rem 22
320 IFX$(I+1)=" ARE"ANDX$(I)+X$(I+1)="YOU
     ARE"THENW$(I+1)="'M"          :rem 96
330 IFRIGHT$(X$(I),3)="'VE"THENW$(I)=LEFT
    $(X$(I),LEN(X$(I))-3)+" HAVE":rem 108
340 IFRIGHT$(X$(I),2)="'D"THENW$(I)=LEFT$
    (X$(I),LEN(X$(I))-2)+" WOULD":rem 123
350 IFRIGHT$(X$(I),4)=" THE"THENW$(I)=LEF
    T$(X$(I),LEN(X$(I))-4):REM DELETE"THE
    "                              :rem 242
360 IFRIGHT$(X$(I),3)=" AN"THENW$(I)="":R
    EM DELETE"AN"                    :rem 9
370 IFRIGHT$(X$(I),2)=" A"THENW$(I)=X$(I+
    1)                              :rem 69
380 NEXT                           :rem 218
390 FORI=1TOJ+1:PRINTW$(I);:NEXT   :rem 19
400 RETURN                         :rem 116
410 X=INT(7*RND(0))+1:PRINT" NO? ";
                                   :rem 170
420 ONXGOTO430,440,450,460,470,480,490
                                     :rem 2
```

```
430 PRINT"WHAT'D YOU EXPECT ME TO SAY?
    {2 SPACES}";IN$(X):RETURN     :rem 231
440 PRINT"IN WHAT WAY? ";:RETURN :rem 185
450 PRINT"I DON'T UNDERSTAND ";:RETURN
                                  :rem 92
460 PRINT"REALLY? ";:RETURN       :rem 200
470 PRINT:RETURN                   :rem 66
480 PRINT"WHY? ";:RETURN          :rem 249
490 PRINT:RETURN                   :rem 68
```

Machine Language For Beginners

(Article on page 103.)

Program 1: Binary Quiz

```
130 C1=209:C0=215
140 X=INT(256*RND(1)): D=X: P=128
160 PRINT CHR$(147)
180 FOR I= 1 TO 8
190 IF INT(D/P) = 1 THEN PRINT CHR$(C1);:
     D=D-P: GOTO 210
200 PRINT CHR$(C0);
210 P=P/2: NEXT I: PRINT
220 PRINT"WHAT IS THIS DECIMAL?"
230 INPUT Q: IF Q=X THEN PRINT"CORRECT":
    {SPACE}GOTO 250
240 PRINT"SORRY, IT WAS";X
250 FOR T= 1 TO 1000: NEXT T
260 GOTO 140
```

Program 2: Binary Table

```
110 L=8:B=2:C=1
120 FORX=0TO255:PRINTX;
140 IFXAND1THENK(C)=49:GOTO160
150 K(C)=48
160 C=C+1:IFBANDXTHENK(C)=49:GOTO180
170 K(C)=48
180 B=B*2:IFC>8THEN200
190 GOTO160
200 FOR I=0TO7:PRINTSTR$(K(L)-48);:L=L-1
210 NEXT
220 C=0:PRINT
260 L=8:B=2:C=1:NEXTX
```

Alpha Anxiety

(Article on page 71.)

Program 1: Alpha Anxiety—VIC Version

```
100 IFPEEK(44)=18THEN120          :rem 102
110 SM=7735:CL=30720:Q1=8141:Q2=7793:GOTO
    130                           :rem 233
120 SM=4151:CL=33792:Q1=4557:Q2=4209
                                  :rem 224
130 JC=37154:J1=37151:J2=37152:S1=36874:S
    2=36876:HS=0                  :rem 157
140 CR$=CHR$(19):FORI=1TO23:CR$=CR$+CHR$(
    17):NEXT                      :rem 110
150 POKE36878,15:POKE36879,25     :rem 116
160 FOR I=1TO15                    :rem 62
170 PRINTCHR$(28)CHR$(147)LEFT$(CR$,9)SPC
    (8)"{BLU}{3 DOWN}ALPHA"       :rem 248
180 PRINTSPC(7)"{BLU}{2 DOWN}ANXIETY"
                                  :rem 59
190 FOR J=1TO100:NEXT             :rem 230
200 PRINTCHR$(28)CHR$(147)LEFT$(CR$,9)SPC
    (8)"{BLU}{2 DOWN}{RVS}ALPHA" :rem 243
210 PRINTSPC(7)"{BLU}{DOWN}{RVS}ANXIETY"
                                  :rem 54
220 FOR J=1TO100: NEXTI           :rem 41
230 DIMP%(25),RL%(5,5)            :rem 114
240 GOSUB1240                     :rem 221
250 RF=0:AT=0                     :rem 216
260 DL=150                        :rem 251
270 SC=0:MA=3:POKE36879,28        :rem 228
280 L1=1:L2=1:LC=1:FL=1:PO=SM:FG=0 :rem 6
290 IFRF=1THENLC=25               :rem 146
300 PRINTCHR$(147)                 :rem 14
310 PRINTTAB(10)CHR$(144)"{A}*{R}*{R}*{R}
    *{R}*{S}"                     :rem 191
320 FOR I=1TO4:PRINTTAB(10)"-{+}-{+}-{+}-
    {+}-{+}-":PRINTTAB(10)"{Q}*+*+*+*+*+
    {W}":NEXT                     :rem 161
330 PRINTTAB(10)"-{+}-{+}-{+}-{+}-{+}-{+}-"
                                  :rem 92
340 PRINT TAB(10) "{Z}*{E}*{E}*{E}*{E}*{E}*
    {X}"                          :rem 223
350 PRINT"{BLU}{HOME}{DOWN}{RIGHT}NEXT":P
    RINT"{RIGHT}LETTER:":PRINT"{DOWN}
    {2 RIGHT}{A}*{S}":PRINT"{2 RIGHT}- -"
    :PRINT"{2 RIGHT}{Z}*{X}"      :rem 28
360 PRINT"{DOWN}{RIGHT}TIME:":PRINT"
    {3 DOWN}{RIGHT}SCORE:":PRINT"{RED}
    {DOWN}{2 RIGHT}";SC:PRINT"{BLU}{DOWN}
    {RIGHT}HIGH":PRINT"{RIGHT}SCORE:"
                                  :rem 171
370 PRINT"{RED}{DOWN}{2 RIGHT}";HS
                                  :rem 168
380 IFSC<2499THENPOKEQ2+CL,5:POKEQ2,LC
                                  :rem 119
390 FORI=Q1+1TOQ1+43:POKEI+CL,4:NEXT
                                  :rem 227

400 TI$="000000":CS=102           :rem 150
410 GOSUB570                      :rem 177
420 IFFG=1THEN280                 :rem 233
430 IFMA=0THEN480                 :rem 236
440 POKES2,0                      :rem 168
450 TL=DL-INT(TI/60)              :rem 161
460 PRINTLEFT$(CR$,11)SPC(2)TL"{LEFT}
    {2 SPACES}"                   :rem 248
470 IFTL>0THEN410                 :rem 252
480 IFSC>HSTHENHS=SC               :rem 55
490 PRINTLEFT$(CR$,18)SPC(11)"GAME OVER!"
                                  :rem 108
500 POKES1,185:FORI=1TO300:NEXT:POKES1,0:
    GOSUB1240                      :rem 99
510 PRINTCHR$(147)"{10 DOWN}PRESS THE FIR
    E BUTTON"                     :rem 111
520 PRINT"{4 SPACES}TO PLAY AGAIN"
                                  :rem 161
530 WAIT37137,32                   :rem 99
540 WAIT37137,32,32               :rem 245
550 PRINTCHR$(147):FORT=1TO500:NEXT
                                  :rem 169
560 GOTO250                       :rem 107
570 POKEJC,127:P=PEEK(J2)AND128    :rem 69
580 JE=-(P=0)                     :rem 164
590 POKEJC,255:P=PEEK(J1)         :rem 218
600 JS=-((PAND8)=0)                 :rem 7
610 JW=-((PAND16)=0)               :rem 59
620 JN=-((PAND4)=0)                 :rem 0
```

```
630 JF=-((PAND32)=0)                    :rem 42
640 TH=PO:T1=L1:T2=L2                   :rem 6
650 IFJFTHENGOSUB790:GOTO720            :rem 21
660 IFJETHENPO=PO+2:L1=L1+1:FL=1        :rem 200
670 IFJSTHENPO=PO+44:L2=L2+1:FL=1       :rem 15
680 IFJWTHENPO=PO-2:L1=L1-1:FL=1        :rem 224
690 IFJNTHENPO=PO-44:L2=L2-1:FL=1       :rem 16
700 IFFL=0THEN780                       :rem 243
710 POKES2,175                          :rem 21
720 IFFG=1THEN780                       :rem 241
730 IFPO<SMORPO>SM+207THENPO=TH:L1=T1:L2=
    T2                                  :rem 33
740 IFPEEK(PO+1)=32ORPEEK(PO-1)=32THENPO=
    TH:L1=T1:L2=T2                      :rem 142
750 POKETH+CL,0:POKETH,CS:CS=PEEK(PO)
                                        :rem 102
760 POKEPO+CL,2:POKEPO,RL%(L1,L2):rem 242
770 FL=0                                :rem 157
780 RETURN                              :rem 127
790 IFRL%(L1,L2)=LCTHENSC=SC+10:GOTO830
                                        :rem 104
800 IFRF=1THEN910                       :rem 246
810 IFRL%(L1,L2)<LCTHEN940              :rem 250
820 GOTO910                             :rem 109
830 POKES2,245:FORT=1TO25:NEXT:POKES2,0
                                        :rem 198
840 IFRF=1THENPOKEQ1+26-LC,LC:GOTO860
                                        :rem 44
850 POKEQ1+LC,LC                        :rem 195
860 IFRF=1THENLC=LC-1:GOTO880           :rem 46
870 LC=LC+1                             :rem 86
880 IFSC>2500THEN900                    :rem 146
890 IFLC<>0THENPOKEQ2,LC                :rem 5
900 CS=RL%(L1,L2):GOTO930               :rem 182
910 POKES1,250:FORT=1TO30:NEXT:POKES1,0
                                        :rem 187
920 DL=DL-10:POKE36879,25+MA:GOTO1230
                                        :rem 133
930 PRINTLEFT$(CR$,15)SPC(2)SC"{LEFT}
    {2 SPACES}"                         :rem 244
940 IFRF=0THEN970                       :rem 0
950 IFLC<>0THEN1230                     :rem 91
960 GOTO980                             :rem 121
970 IFLC<>26THEN1230                    :rem 149
980 IFSC>5000THEN1040                   :rem 189
990 AT=AT+DL-TL                         :rem 145
1000 IFSC=5000THENDL=INT(AT/20):GOTO1090
                                        :rem 131
1010 IFTL<150THENDL=TL*2+40:GOTO1090
                                        :rem 135
1020 IFTL>300THENDL=TL*.5:GOTO1090:rem 41
1030 DL=TL                              :rem 49
1040 IFSC=6000THENDL=DL-5               :rem 219
1050 IFSC=7000THENDL=DL-5               :rem 221
1060 IFSC=8000THENDL=DL-5               :rem 223
1070 IFSC=9000THENDL=DL-5               :rem 225
1080 IFSC=10000THENDL=DL-5              :rem 10
1090 FORI=1TO3                          :rem 62
1100 POKES2,225:FORT=1TO250:NEXT        :rem 209
1110 POKES2,0:FORT=1TO25:NEXT           :rem 57
1120 NEXTI                              :rem 76
1130 FORI=1TO2                          :rem 56
1140 POKES2,231:FORT=1TO250:NEXT        :rem 210
1150 POKES2,0:FORT=1TO25:NEXT           :rem 61
1160 POKES2,225:FORT=1TO250:NEXT        :rem 215
1170 POKES2,0:FORT=1TO25:NEXT           :rem 63
1180 NEXTI                              :rem 82
1190 POKES2,240:FORT=1TO250:NEXT:POKES2,0
                                        :rem 33
1200 IFSC>1250THENRF=1                  :rem 35
1210 GOSUB1240                          :rem 11
1220 FG=1                               :rem 192
1230 RETURN                             :rem 166
1240 FORI=1TO25:P%(I)=I:NEXT            :rem 183
1250 FORI=1TO5                          :rem 62
1260 FORJ=1TO5                          :rem 64
1270 R=INT(RND(1)*25+1)                 :rem 232
1280 IFP%(R)=0THEN1270                  :rem 216
1290 RL%(I,J)=R                         :rem 46
1300 P%(R)=0                            :rem 73
1310 NEXTJ                              :rem 78
1320 NEXTI                              :rem 78
1330 RETURN                             :rem 167
```

Program 2: Alpha Anxiety—64 Version

```
100 SD=54272:FORI=SDTOSD+24:POKEI,0:NEXT:
    POKESD+5,26:POKESD+6,191:POKE54296,15
                                        :rem 26
110 SM=1280:CL=54272:Q1=1905:Q2=1227
                                        :rem 210
120 HS=0:JC=56320                       :rem 159
130 CR$=CHR$(19):FORI=1TO23:CR$=CR$+CHR$(
    17):NEXT:POKE53281,1                :rem 54
140 FORI=1TO7                           :rem 13
150 PRINTCHR$(31)CHR$(147)LEFT$(CR$,9)SPC
    (12)"{4 DOWN}ALPHA ANXIETY"         :rem 47
160 FOR J=1TO50:NEXT                    :rem 183
170 PRINTCHR$(31)CHR$(147)LEFT$(CR$,9)SPC
    (12)"{3 DOWN}{RVS}ALPHA ANXIETY"
                                        :rem 50
180 FOR J=1TO100:NEXTI                  :rem 46
190 DIMP%(25),RL%(5,5)                  :rem 119
200 GOSUB1150                           :rem 217
210 RF=0:AT=0                           :rem 212
220 DL=150                              :rem 247
230 SC=0:MA=3                           :rem 208
240 L1=1:L2=1:LC=1:FL=1:PO=SM:FG=0      :rem 2
250 IFRF=1THENLC=25                     :rem 142
260 PRINTCHR$(147)                      :rem 19
270 PRINT"{4 DOWN}"TAB(15)"{BLK}{A}*{R}*
    {R}*{R}*{R}*{S}"                    :rem 246
280 FOR I=1TO4:PRINTTAB(15)"-{RVS} {OFF}-
    {RVS} {OFF}-{RVS} {OFF}-{RVS} {OFF}-
    {RVS} {OFF}-":PRINTTAB(15)"{Q}*+*+*+*
    +*{W}"                              :rem 45
290 NEXT:PRINTTAB(15)"-{RVS} {OFF}-{RVS}
    {SPACE}{OFF}-{RVS} {OFF}-{RVS} {OFF}-
    {RVS} {OFF}-"                       :rem 213
300 PRINTTAB(15) "{Z}*{E}*{E}*{E}*{E}*{X}
    "                                   :rem 224
310 PRINT"{BLU}{HOME}{DOWN}{RIGHT}NEXT":P
    RINT"{RIGHT}LETTER:":PRINT"{RED}
    {DOWN}{2 RIGHT}{A}*{S}":PRINT"{RED}
    {2 RIGHT}- -":PRINT"{RED}{2 RIGHT}{Z}
    *{X}"                               :rem 108
320 PRINT"{BLU}{DOWN}{RIGHT}TIME:":PRINT"
    {BLU}{3 DOWN}{RIGHT}SCORE:":PRINT"
    {RED}{DOWN}{2 RIGHT}"SC:            :rem 142
330 PRINT"{BLU}{DOWN}{RIGHT}HIGH":PRINT"
    {RIGHT}SCORE:"                      :rem 178
340 PRINT"{RED}{DOWN}{2 RIGHT}";HS
                                        :rem 165
350 IFSC<2499THENPOKEQ2+CL,6:POKEQ2,LC
                                        :rem 117
360 FORI=Q1+CLTOQ1+CL+26:POKEI,0:NEXT
                                        :rem 59
370 TI$="000000":CS=160                 :rem 160
380 GOSUB530                            :rem 179
390 IFFG=1THEN240                       :rem 235
400 IFMA=0THEN450                       :rem 230
410 POKESD+4,17:POKESD+1,0              :rem 6
```

```
420 TL=DL-INT(TI/60)                    :rem 158
430 PRINTLEFT$(CR$,11)SPC(2)TL"{LEFT}
    {2 SPACES}"                         :rem 245
440 IFTL>0THEN380                       :rem 255
450 IFSC>HSTHENHS=SC                    :rem 52
460 PRINT"{CLR}{BLU}{9 DOWN}{15 SPACES}
    {RVS}GAME OVER"                     :rem 30
470 PRINT"{BLU}{3 DOWN}{9 SPACES}PRESS TH
    E FIRE BUTTON"                      :rem 46
480 PRINT"{DOWN}{13 SPACES}TO PLAY AGAIN"
                                        :rem 183
490 POKESD+1,85:FORI=1TO400:NEXT:POKESD+1
    ,0:GOSUB1150                        :rem 25
500 A=NOTPEEK(JC)AND16:IFA=0THEN500
                                        :rem 124
510 PRINTCHR$(147):FORT=1TO500:NEXT
                                        :rem 165
520 GOTO210                             :rem 99
530 P=NOTPEEK(JC)AND31                  :rem 80
540 JE=(P=8)                            :rem 123
550 JS=(P=2)                            :rem 132
560 JW=(P=4)                            :rem 139
570 JN=(P=1)                            :rem 128
580 JF=(P=16)                           :rem 175
590 TH=PO:T1=L1:T2=L2                   :rem 10
600 IFJFTHENGOSUB740:GOTO670            :rem 15
610 IFJETHENPO=PO+2:L1=L1+1:FL=1        :rem 195
620 IFJSTHENPO=PO+80:L2=L2+1:FL=1       :rem 10
630 IFJWTHENPO=PO-2:L1=L1-1:FL=1        :rem 219
640 IFJNTHENPO=PO-80:L2=L2-1:FL=1       :rem 11
650 IFFL=0THEN730                       :rem 242
660 POKESD+1,50                         :rem 79
670 IFFG=1THEN730                       :rem 240
680 IFPO<SMORPO>SM+376THENPO=TH:L1=T1:L2=
    T2                                  :rem 44
690 IFPEEK(PO+1)=32ORPEEK(PO-1)=32THENPO=
    TH:L1=T1:L2=T2                      :rem 146
700 POKETH+CL,0:POKETH,CS:CS=PEEK(PO)
                                        :rem 97
710 POKEPO+CL,2:POKEPO,RL%(L1,L2):rem 237
720 FL=0                                :rem 152
730 RETURN                              :rem 122
740 IFRL%(L1,L2)=LCTHENSC=SC+10:GOTO780
                                        :rem 103
750 IFRF=1THEN860                       :rem 254
760 IFRL%(L1,L2)<LCTHEN900              :rem 250
770 GOTO860                             :rem 117
780 POKESD+1,100:FORT=1TO25:NEXT:POKESD+1
    ,0                                  :rem 156
790 IFRF=1THENPOKEQ1+26-LC,LC:GOTO810
                                        :rem 43
800 POKEQ1+LC,LC                        :rem 190
810 IFRF=1THENLC=LC-1:GOTO830           :rem 36
820 LC=LC+1                             :rem 81
830 IFSC>2500THEN850                    :rem 145
840 IFLC<>0THENPOKEQ2,LC                :rem 0
850 CS=RL%(L1,L2):GOTO890               :rem 191
860 POKESD+1,20:FORT=1TO30:NEXT:POKESD+1,
    0                                   :rem 104
870 DL=DL-10:IFDL<=0THENGOTO460         :rem 142
880 RETURN                              :rem 128
890 PRINTLEFT$(CR$,15)SPC(2)SC"{LEFT}
    {2 SPACES}"                         :rem 249
900 IFRF=0THEN930                       :rem 248
910 IFLC<>0THEN1140                     :rem 87
920 GOTO940                             :rem 113
930 IFLC<>26THEN1140                    :rem 145
940 IFSC>5000THEN1000                   :rem 181
950 AT=AT+DL-TL                         :rem 141
960 IFSC=5000THENDL=INT(AT/20):GOTO1050
                                        :rem 93
970 IFTL<150THENDL=40+TL*2:GOTO1050
                                        :rem 97
980 IFTL>300THENDL=TL*.5:GOTO1050       :rem 3
990 DL=TL                               :rem 15
1000 IFSC=6000THENDL=DL-5               :rem 215
1010 IFSC=7000THENDL=DL-5               :rem 217
1020 IFSC=8000THENDL=DL-5               :rem 219
1030 IFSC=9000THENDL=DL-5               :rem 221
1040 IFSC=10000THENDL=DL-5              :rem 6
1050 H=SD+1:L=SD:POKEH,8:POKEL,97:GOSUB10
     80                                 :rem 129
1060 POKEH,12:POKEL,143:GOSUB1080:POKEH,1
     4:POKEL,24:GOSUB1080               :rem 213
1070 POKEH,12:POKEL,143:POKESD+4,17:FORI=
     1TO800:NEXTI:POKEH,0:POKEL,0:GOTO111
     0                                  :rem 99
1080 POKESD+4,17:FORI=1TO200:NEXT:POKESD+
     4,16:FORI=1TO100:NEXT              :rem 127
1090 POKESD+4,17:FORI=1TO200:NEXT:POKESD+
     4,16:FORI=1TO100:NEXT              :rem 128
1100 RETURN                             :rem 162
1110 IFSC>1250THENRF=1                  :rem 35
1120 GOSUB1150                          :rem 11
1130 FG=1                               :rem 192
1140 RETURN                             :rem 166
1150 FORI=1TO25:P%(I)=I:NEXT            :rem 183
1160 FORI=1TO5                          :rem 62
1170 FORJ=1TO5                          :rem 64
1180 R=INT(RND(1)*25+1)                 :rem 232
1190 IFP%(R)=0THEN1180                  :rem 216
1200 RL%(I,J)=R                         :rem 37
1210 P%(R)=0                            :rem 73
1220 NEXTJ                              :rem 78
1230 NEXTI                              :rem 78
1240 RETURN                             :rem 167
```

Disk Directory Sort

(Article on page 113.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

```
10 GOSUB340:GOTO150                     :rem 129
20 PRINT"{DOWN}SORTING":SK=K1:L%(K1)=K1:R
   %(1)=NF                              :rem 176
30 L1=L%(SK):R1=R%(SK):SK=SK-1          :rem 238
40 L2=L1:R2=R1:KE$=NS$(INT((L1+R1)/2))
                                        :rem 116
50 KE$=MID$(KE$,31)+MID$(KE$,4,M%(INT((L1
   +R1)/2)))                            :rem 127
60 IFMID$(NS$(L2),31)+MID$(NS$(L2),4,M%(L
   2))<KE$THENL2=L2+K1:GOTO60           :rem 27
70 IFKE$<MID$(NS$(R2),31)+MID$(NS$(R2),4,
   M%(R2))THENR2=R2-K1:GOTO70           :rem 61
80 IFL2>R2THEN110                       :rem 248
90 N$=NS$(R2):H=M%(R2):NS$(R2)=NS$(L2):M%
   (R2)=M%(L2)                          :rem 92
100 NS$(L2)=N$:M%(L2)=H:L2=L2+1:R2=R2-1:G
    OTO60                               :rem 89
110 IFL2<R1THENSK=SK+1:L%(SK)=L2:R%(SK)=R
    1                                   :rem 23
120 R1=R2:IFL1<R1THEN40                 :rem 111
130 IFSKTHEN30                          :rem 83
140 RETURN                              :rem 117
150 NF=0:GOSUB300                       :rem 228
```

```
160 GOSUB320:FORPP=1TO8:R$="":FL=0:M%(NF+
    1)=16:FORX=1TO30:GET#5,I$     :rem 169
170 IFI$=CHR$(160)ANDFL=0THENM%(NF+1)=X-4
    :FL=1                         :rem 158
180 R$=R$+LEFT$(I$+C0$,1):NEXT:IFPP<>8THE
    NGET#5,I$,I$                  :rem 70
190 X$=C0$:IFMID$(R$,1,1)=C0$THENX$=CHR$(
    255):PRINTDD$;                :rem 138
200 NF=NF+1:NS$(NF)=R$+X$:PRINTMID$(R$,4,
    16):NEXTPP:IFYS<>255THEN160   :rem 122
210 CLOSE5:GOSUB20                :rem 90
220 PRINT"{DOWN}PRESS SPACE BAR TO REWRIT
    E DIRECTORY"                  :rem 62
230 GETA$:IFA$<>" "THEN230        :rem 138
240 GOSUB300:NN=0                 :rem 236
250 GOSUB320:FORPP=1TO8:NN=NN+1   :rem 193
260 PRINT#5,MID$(NS$(NN),1,30);:IFMID$(NS
    $(NN),31)=CHR$(255)THENPRINTDD$;
                                  :rem 249
270 PRINTMID$(NS$(NN),4,16):IFPP<>8THENPR
    INT#5,C0$;C0$;                :rem 25
280 NEXTPP:PRINT#15,"U2";5;0;LT;LS:IFYS<>
    255THEN250                    :rem 161
290 CLOSE5:END                    :rem 87
300 OPEN5,8,5,"#":YT=18:YS=0:GOSUB320:PRI
    NT#15,"B-P";5;143:PRINTCHR$(14)
                                  :rem 193
310 PRINTRN$;:FORX=1TO24:GET#5,I$:PRINTI$
    ;:NEXT:PRINTRF$:RETURN        :rem 160
320 PRINT#15,"U1";5;0;YT;YS:LT=YT:LS=YS:G
    ET#5,T$,S$:YT=ASC(T$+C0$)     :rem 16
330 YS=ASC(S$+C0$):RETURN         :rem 250
340 X=150:DIM L%(X),M%(X),R%(X),NS$(X):K1
    =1:OPEN15,8,15,"I":C0$=CHR$(0):NF=0
                                  :rem 141
350 DD$="::::::::::::::DELETED{5 SPACES}":RN$=CH
    R$(18):RF$=CHR$(146):RETURN   :rem 190
```

Disk Handler

(Article on page 114.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Note: See special instructions in article. Requires at least 3K expansion to work on a VIC (8K or more is also acceptable).

```
340 IF JJ$="S" THEN GOSUB 780     :rem 0
438 K=0:FORJ=0TO63:IFJ=16ORJ=32ORJ=48THEN
    GOSUB710:IFZ$="N"THENJ=80:GOTO458
                                  :rem 162
439 PRINT#15,"B-P:2"+STR$(J*4)    :rem 146
458 NEXT J:IF J<80 THEN GOSUB710  :rem 40
459 GOTO 571                      :rem 120
575 PRINT"{CLR}NEXT TRACK AND SECTOR"NB(1
    )NB(2) "{DOWN}"               :rem 214
580 PRINT"DO YOU WANT NEXT TRACK AND SECT
    OR(Y/N)","{2 SPACES}OR{2 SPACES}END
    {2 SPACES}(E)                 :rem 18
615 IF Z$="E" THEN 9999{20 SPACES}: REM E
    ND PROGRAM                    :rem 143
710 REM*****************************
                                  :rem 104
720 REM* SCREEN CONTINUE MESSAGE
    {4 SPACES}*                   :rem 251
730 REM*****************************
                                  :rem 106
740 PRINT"{4 RIGHT}CONTINUE(Y/N)","
    {RIGHT}{3 SPACES}CHANGE{2 SPACES}(C)"
    ,"{4 SPACES}REWRITE (W)",     :rem 153
741 PRINT"{4 SPACES}END{5 SPACES}(E)"
                                  :rem 218
750 GETZ$:IF Z$="" THEN 750       :rem 141
755 IF Z$="C" THEN 950{21 SPACES}: REM CH
    ANGE DATA IN{2 SPACES}BUFFER :rem 110
760 IF Z$="N" THEN RETURN{18 SPACES}: REM
     DON'T CONTINUE               :rem 103
765 IF Z$="W"{2 SPACES}THEN 1100
    {19 SPACES}: REM REWRITE BLOCK:rem 35
767 IF Z$="E" THEN 9999{20 SPACES}: REM E
    ND                            :rem 127
770 IF Z$<>"Y" THEN 750{20 SPACES}: REM I
    NVALID OPTION                 :rem 139
780 PRINT"{CLR}{RVS}TRACK ";T;"{LEFT} SEC
    TOR"S"{OFF}":RETURN            :rem 72
950 REM*********************      :rem 30
951 REM*{20 SPACES}*              :rem 215
952 REM* CHANGE DATA ON DISK*      :rem 96
953 REM*{20 SPACES}*              :rem 217
954 REM*********************       :rem 34
955 Z9$=""                        :rem 219
960 PRINT"ENTER STARTING POINT{2 SPACES}F
    OR CHANGE 0-FF":INPUT CS$     :rem 222
961 FORZ=0 TO LEN(HX$):IF MID$(HX$,Z+1,1)
    =LEFT$(CS$,1)THENTX=Z*16      :rem 247
962 IF MID$(HX$,Z+1,1)=RIGHT$(CS$,1)THENT
    Y=Z                           :rem 60
963 NEXT:CS=TY+TX                 :rem 114
970 PRINT#15,"B-P:2",CSTART{16 SPACES}: R
    EM POSITION TO START           :rem 18
990 GET#2,A$(0)                   :rem 233
995 IF A$(0)=""THEN A$(0)=NL$     :rem 173
1000 N=ASC(A$(0))                  :rem 90
1010 A$="":GOSUB 790:GOSUB2000: PRINT"-";
     {2 SPACES}: REM DISPLAY BYTE IN HEX
                                  :rem 213
1015 N1=0                         :rem 179
1017 FOR J1=1TO0 STEP-1             :rem 6
1020 GET Z$:IF Z$=""THEN 1020{14 SPACES}:
      REM GET 2 CHARACTERS        :rem 235
1022 IFZ$=","THENN1=N:J1=-1:GOTO1040
     {7 SPACES}: REM HANDLE COMMA KEY
                                  :rem 96
1024 IF Z$=CHR$(13)THENJ1=-1:GOTO1040
     {6 SPACES}: REM HANDLE RETURN KEY
                                  :rem 215
1025 REM CONVERT HEX ENTRY TO DECIMAL EQU
    IVALENT                       :rem 212
1030 FORI=1TO16:IF Z$=MID$(HX$,I,1)THEN N
    1=N1+(I-1)*(16↑J1)             :rem 29
1032 NEXT I                       :rem 78
1040 NEXTJ1:IFZ$=CHR$(13)THENPRINTZ$:PRIN
    T#15,"B-P:2",CS:PRINT#2,Z9$;:GOTO740
                                  :rem 232
1041 REM IF RETURN KEY HIT MAKE CHANGES I
    N DISK BUFFER                 :rem 122
1045 N=N1:A$="":GOSUB790:GOSUB2000:PRINT"
    ,";                           :rem 60
1050 REM ADD NEWLY CHANGED BYTE TO PREV C
    HANGES IN Z9$                 :rem 71
1052 Z9$=Z9$+CHR$(N):GOTO 990     :rem 83
1100 REM*********************     :rem 66
```

```
1101 REM*{20 SPACES}*                  :rem 251
1102 REM* REWRITE BLOCK{6 SPACES}*
                                       :rem 137
1103 REM*{20 SPACES}*                  :rem 253
1105 REM**********************          :rem 71
1110 PRINT#15,"U2:2,"D$;T;S:GOSUB650
                                       :rem 66
1120 PRINT"TRACK ";T;" SECTOR ";S,"HAS BE
     EN REWRITTEN"                     :rem 160
1130 GOTO 740                          :rem 153
2000 PRINTLEFT$(A$,2);:RETURN           :rem 7
9999 CLOSE2:CLOSE15:CLOSE4             :rem 134
```

MLX

(Article on page 122.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

64 MLX

```
10 REM LINES CHANGED FROM MLX VERSION 2.0
   0 ARE 750,765,770 AND 860           :rem 50
20 REM LINE CHANGED FROM MLX VERSION 2.01
    IS 300                             :rem 147
100 PRINT"{CLR}{6}";CHR$(142);CHR$(8);:PO
    KE53281,1:POKE53280,1              :rem 67
101 POKE 788,52:REM DISABLE RUN/STOP
                                       :rem 119
110 PRINT"{RVS}{39 SPACES}";           :rem 176
120 PRINT"{RVS}{14 SPACES}{RIGHT}{OFF}{*}
    £{RVS}{RIGHT} {RIGHT}{2 SPACES}{*}
    {OFF}{*}£{RVS}£{RVS}{14 SPACES}";
                                       :rem 250
130 PRINT"{RVS}{14 SPACES}{RIGHT} {G}
    {RIGHT} {2 RIGHT} {OFF}£{RVS}£{*}
    {OFF}{*}{RVS}{14 SPACES}";         :rem 35
140 PRINT"{RVS}{41 SPACES}"            :rem 120
200 PRINT"{2 DOWN}{PUR}{BLK} MACHINE LANG
    UAGE EDITOR VERSION 2.02{5 DOWN}"
                                       :rem 238
210 PRINT"{5}{2 UP}STARTING ADDRESS?
    {8 SPACES}{9 LEFT}";               :rem 143
215 INPUTS:F=1-F:C$=CHR$(31+119*F)
                                       :rem 166
220 IFS<256OR(S>40960ANDS<49152)ORS>53247
    THENGOSUB3000:GOTO210              :rem 235
225 PRINT:PRINT:PRINT                  :rem 180
230 PRINT"{5}{2 UP}ENDING ADDRESS?
    {8 SPACES}{9 LEFT}";:INPUTE:F=1-F:C$=
    CHR$(31+119*F)                     :rem 20
240 IFE<256OR(E>40960ANDE<49152)ORE>53247
    THENGOSUB3000:GOTO230              :rem 183
250 IFE<STHENPRINTC$;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
                                       :rem 176
260 PRINT:PRINT:PRINT                  :rem 179
300 PRINT"{CLR}";CHR$(14):AD=S         :rem 56
310 A=1:PRINTRIGHT$("0000"+MID$(STR$(AD),
    2),5);":";                         :rem 33
315 FORJ=ATO6                          :rem 33
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
                                       :rem 228
390 IFN=-211THEN 710                   :rem 62
400 IFN=-204THEN 790                   :rem 64
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ                     :rem 44
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
                                       :rem 225
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
                                       :rem 238
420 IF N<>-196 THEN 480                :rem 133
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT                          :rem 234
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0                                  :rem 159
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":";         :rem 30
451 FORK=0TO5:N=PEEK(I+K):PRINTRIGHT$("00
    "+MID$(STR$(N),2),3);",";          :rem 66
460 GETA$:IFA$>""THENPRINT:PRINT:GOTO310
                                       :rem 25
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310                          :rem 50
480 IFN<0 THEN PRINT:GOTO310           :rem 168
490 A(J)=N:NEXTJ                       :rem 199
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT        :rem 200
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(146
    );                                 :rem 94
511 IFN=-1THENA=6:GOTO315              :rem 254
515 PRINTCHR$(20):IFN=CKSUMTHEN530
                                       :rem 122
520 PRINT:PRINT"LINE ENTERED WRONG : RE-E
    NTER":PRINT:GOSUB1000:GOTO310:rem 176
530 GOSUB2000                          :rem 218
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:POKE54
    272,0:POKE54273,0                  :rem 227
550 AD=AD+6:IF AD<E THEN 310           :rem 212
560 GOTO 710                           :rem 108
570 N=0:Z=0                             :rem 88
580 PRINT"{£}";                        :rem 81
581 GETA$:IFA$=""THEN581                :rem 95
582 AV=-(A$="M")-2*(A$=",")-3*(A$=".")-4*
    (A$="J")-5*(A$="K")-6*(A$="L"):rem 41
583 AV=AV-7*(A$="U")-8*(A$="I")-9*(A$="O"
    ):IFA$="H"THENA$="0"               :rem 134
584 IFAV>0THENA$=CHR$(48+AV)           :rem 134
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670                      :rem 229
590 IFA>128THENN=-A:RETURN             :rem 137
600 IFA<>20 THEN 630                    :rem 10
610 GOSUB690:IFI=1ANDT=44THENN=-1:PRINT"
    {OFF}{LEFT} {LEFT}";:GOTO690       :rem 62
620 GOTO570                            :rem 109
630 IFA<48ORA>57THEN580                :rem 105
640 PRINTA$;:N=N*10+A-48               :rem 106
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
                                       :rem 229
660 Z=Z+1:IFZ<3THEN580                  :rem 71
670 IFZ=0THENGOSUB1000:GOTO570         :rem 114
680 PRINT",";:RETURN                   :rem 240
690 S%=PEEK(209)+256*PEEK(210)+PEEK(211)
                                       :rem 149
691 FORI=1TO3:T=PEEK(S%-I)              :rem 67
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
                                       :rem 205
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
                                        :rem 7
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
                                       :rem 236
715 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
     ALONE TO CANCEL SAVE){DOWN}":rem 106
720 F$="":INPUT"{DOWN} FILENAME";F$:IFF$=
    ""THENPRINT:PRINT:GOTO310          :rem 71
```

```
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"          :rem 228
740 GETA$:IFA$<>"T"ANDA$<>"D"THEN740
                                    :rem 36
750 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$:
    OPEN15,8,15,"S"+F$:CLOSE15      :rem 212
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                :rem 3
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                    :rem 109
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                              :rem 69
765 K=S:POKE254,K/256:POKE253,K-PEEK(254)
    *256:POKE780,253                :rem 17
766 K=E+1:POKE782,K/256:POKE781,K-PEEK(78
    2)*256:SYS65496                 :rem 235
770 IF(PEEK(783)AND1)OR(191ANDST)THEN780
                                    :rem 111
775 PRINT"{DOWN}DONE.{DOWN}":GOTO310
                                    :rem 113
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720        :rem 171
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720            :rem 103
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
                                    :rem 212
795 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
     ALONE TO CANCEL LOAD)"         :rem 82
800 F$="":INPUT"{2 DOWN} FILENAME";F$:IFF
    $=""THENPRINT:GOTO310           :rem 144
810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"          :rem 227
820 GETA$:IFA$<>"T"ANDA$<>"D"THEN820
                                    :rem 34
830 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                    :rem 157
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                :rem 2
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                    :rem 107
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                              :rem 70
850 POKE780,0:SYS65493              :rem 11
860 IF(PEEK(783)AND1)OR(191ANDST)THEN870
                                    :rem 111
865 PRINT"{DOWN}DONE.":GOTO310      :rem 96
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
    RY AGAIN.{DOWN}":IFDV=1THEN800
                                    :rem 172
880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO800            :rem 102
1000 REM BUZZER                     :rem 135
1001 POKE54296,15:POKE54277,45:POKE54278,
     165                            :rem 207
1002 POKE54276,33:POKE 54273,6:POKE54272,
     5                              :rem 42
1003 FORT=1TO200:NEXT:POKE54276,32:POKE54
     273,0:POKE54272,0:RETURN       :rem 202
2000 REM BELL SOUND                 :rem 78
2001 POKE54296,15:POKE54277,0:POKE54278,2
     47                             :rem 152
2002 POKE 54276,17:POKE54273,40:POKE54272
     ,0                             :rem 86
2003 FORT=1TO100:NEXT:POKE54276,16:RETURN
                                    :rem 57
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
     GOTO1000                       :rem 89
```

VIC MLX

```
100 PRINT"{CLR}{PUR}";CHR$(142);CHR$(8);
                                    :rem 181
101 POKE 788,194:REM DISABLE RUN/STOP
                                    :rem 174
110 PRINT"{RVS}{14 SPACES}"         :rem 117
120 PRINT"{RVS} {RIGHT}{OFF}£{*3}£{RVS}
    {RIGHT} {RIGHT}{2 SPACES}£{*3}{OFF}£{*3
    £{RVS}£{RVS} "                  :rem 191
130 PRINT"{RVS} {RIGHT} £G3{RIGHT}
    {2 RIGHT} {OFF}£{RVS}£{*3}{OFF}£{*3}
    {RVS} "                         :rem 232
140 PRINT"{RVS}{14 SPACES}"         :rem 120
200 PRINT"{2 DOWN}{PUR}{BLK}A FAILSAFE MA
    CHINE":PRINT"LANGUAGE EDITOR{5 DOWN}"
                                    :rem 141
210 PRINT"{BLK}{3 UP}STARTING ADDRESS":IN
    PUTS:F=1-F:C$=CHR$(31+119*F)    :rem 97
220 IFS<256ORS>32767THENGOSUB3000:GOTO210
                                    :rem 2
225 PRINT:PRINT:PRINT:PRINT         :rem 123
230 PRINT"{BLK}{3 UP}ENDING ADDRESS":INPU
    TE:F=1-F:C$=CHR$(31+119*F)      :rem 158
240 IFE<256ORE>32767THENGOSUB3000:GOTO230
                                    :rem 234
250 IFE<STHENPRINTC$;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
                                    :rem 176
260 PRINT:PRINT:PRINT               :rem 179
300 PRINT"{CLR}";CHR$(14):AD=S      :rem 56
310 PRINTRIGHT$("0000"+MID$(STR$(AD),2),5
    );":";:FORJ=1TO6                :rem 234
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
                                    :rem 228
390 IFN=-211THEN 710                :rem 62
400 IFN=-204THEN 790                :rem 64
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ                  :rem 44
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
                                    :rem 225
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
                                    :rem 238
420 IF N<>-196 THEN 480             :rem 133
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT                       :rem 234
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0                               :rem 159
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":";      :rem 30
455 FORK=0TO5:N=PEEK(I+K):IFK=3THENPRINTS
    PC(10);                         :rem 34
457 PRINTRIGHT$("00"+MID$(STR$(N),2),3);"
    ,";                             :rem 157
460 GETA$:IFA$>""THENPRINT:PRINT:GOTO310
                                    :rem 25
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310                       :rem 50
480 IFN<0 THEN PRINT:GOTO310        :rem 168
490 A(J)=N:NEXTJ                    :rem 199
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT     :rem 200
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(20)
                                    :rem 234
515 IFN=CKSUMTHEN530                :rem 255
520 PRINT:PRINT"LINE ENTERED WRONG":PRINT
    "RE-ENTER":PRINT:GOSUB1000:GOTO310
                                    :rem 129
530 GOSUB2000                       :rem 218
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:rem 80
550 AD=AD+6:IF AD<E THEN 310        :rem 212
560 GOTO 710                        :rem 108
570 N=0:Z=0                         :rem 88
```

```
580 PRINT"{3 RIGHT}";                          :rem 79
581 GETA$:IFA$=""THEN581                       :rem 95
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670                              :rem 229
590 IFA>128THENN=-A:RETURN                     :rem 137
600 IFA<>20 THEN 630                           :rem 10
610 GOSUB690:IFI=1ANDT=44THENN=-1:PRINT"
    {LEFT} {LEFT}";:GOTO690                    :rem 172
620 GOTO570                                    :rem 109
630 IFA<48ORA>57THEN580                        :rem 105
640 PRINTA$;:N=N*10+A-48                       :rem 106
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
                                               :rem 229
660 Z=Z+1:IFZ<3THEN580                         :rem 71
670 IFZ=0THENGOSUB1000:GOTO570                 :rem 114
680 PRINT",";:RETURN                           :rem 240
690 S%=PEEK(209)+256*PEEK(210)+PEEK(211)
                                               :rem 149
692 FORI=1TO3:T=PEEK(S%-I)                     :rem 68
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
                                               :rem 205
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
                                               :rem 7
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
                                               :rem 236
720 INPUT"{DOWN} FILENAME";F$                  :rem 228
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"                     :rem 228
740 GETA$:IFA$<>"T"ANDA$<>"D"THEN740
                                               :rem 36
750 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                               :rem 158
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                           :rem 3
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                               :rem 109
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                                         :rem 69
765 POKE254,S/256:POKE253,S-PEEK(254)*256
    :POKE780,253                               :rem 12
766 POKE782,E/256:POKE781,E-PEEK(782)*256
    :SYS65496                                  :rem 124
770 IF(PEEK(783)AND1)OR(ST AND191)THEN780
                                               :rem 111
775 PRINT"{DOWN}DONE.":END                     :rem 106
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720                   :rem 171
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720                       :rem 103
782 GOTO720                                    :rem 115
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
                                               :rem 212
800 INPUT"{2 DOWN} FILENAME";F$                :rem 244
810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"                     :rem 227
820 GETA$:IFA$<>"T"ANDA$<>"D"THEN820
                                               :rem 34
830 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                               :rem 157
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                           :rem 2
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                               :rem 107
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                                         :rem 70
850 POKE780,0:SYS65493                         :rem 11
860 IF(PEEK(783)AND1)OR(ST AND191)THEN870
                                               :rem 111
865 PRINT"{DOWN}DONE.":GOTO310                 :rem 96
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
    RY AGAIN.{DOWN}":IFDV=1THEN800
                                               :rem 172
880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO800                       :rem 102
1000 REM BUZZER                                :rem 135
1001 POKE36878,15:POKE36874,190                :rem 206
1002 FORW=1TO300:NEXTW                         :rem 117
1003 POKE36878,0:POKE36874,0:RETURN
                                               :rem 74
2000 REM BELL SOUND                            :rem 78
2001 FORW=15TO0STEP-1:POKE36878,W:POKE368
    76,240:NEXTW                               :rem 22
2002 POKE36876,0:RETURN                        :rem 119
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
    GOTO1000                                   :rem 89
```

Heat Seeker

(Article on page 56.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Heat Seeker—VIC Version

```
100 GOTO500                                    :rem 95
110 GOSUB650:IFPEEK(653)=1THEN110:rem 185
120 FORR=0TO7:J=PEEK(37137)AND44:IFJ<>44T
    HEN380                                     :rem 73
130 IFC=7679THEN180                            :rem 72
140 POKEC,32:C=C+C1                            :rem 52
150 IFC>8163ORC<7724THENC=7679:GOTO180
                                               :rem 4
160 GE=PEEK(C):IFGE<>32THEN450                 :rem 21
170 POKEC,G                                    :rem 125
180 IFR=2ORR=6THENNEXT:GOTO110                 :rem 194
190 POKEB,32                                   :rem 156
200 B=B+D(B1):IFB=ATHEN300                     :rem 209
210 IFPEEK(B)=16ORB<7724THENB1=B1+4+(B1>4
    )*8:GOTO200                                :rem 234
220 IFPEEK(B)=0THEN430                         :rem 14
230 POKEB,17:IFR=INT(R/2)*2THEN260 :rem 4
240 Y=INT(D(B1)/21+.5):X=D(B1)-22*Y
                                               :rem 123
250 V=INT((A-B)/21+.5):H=A-B-V*22:B1=B1+S
    GN(X*V-Y*H):B1=B1+((B1>8)-(B1<1))*8
                                               :rem 107
260 IFR=0THENNEXT:GOTO110                      :rem 89
270 POKEA,32:A=A+D(A1):IFPEEK(A)<>32THEN3
    00                                         :rem 230
280 IFA<7724THENA1=A1+4+8*(A1>4):GOTO270
                                               :rem 247
290 POKEA,A1+7:NEXT:GOTO110                    :rem 137
300 AE=PEEK(A):POKEA,18:GOSUB620:POKEB,32
    :POKEC,32:IFA<8164THENPOKEA,32:GOTO32
    0                                          :rem 104
310 POKEA,16                                   :rem 151
320 IFAE=0THENK=K+1:IFK=11THEN560:rem 242
330 L=L-1:IFL>0THEN600                         :rem 17
340 GOSUB650:POKE198,0:PRINT"{HOME}
    {10 DOWN}{3 RIGHT}{RVS}PLAY AGAIN?(Y/
    N)"                                        :rem 70
350 GETA$:IFA$="Y"THEN500                      :rem 169
360 IFA$="N"THENSYS58648:END                   :rem 170
370 GOTO350                                    :rem 107
380 IF(JAND8)=0THENA1=A1-1-8*(A1=1)
                                               :rem 171
```

```
390 IF(JAND4)=0THENA1=A1+1+8*(A1=8)
                                   :rem 171
400 IFJAND32THEN130                :rem 104
410 POKEC,32:C1=D(A1):C=A+C1+C1:G=A1:IFG=
    8THENG=4                       :rem 95
420 POKEV0,15:POKES2,190:POKES4,180:FORT=
    1TO20:NEXT:POKEV0,0:GOTO150    :rem 57
430 SC=SC+50:K=K+1:IFK=11THEN560   :rem 118
440 POKEB,18:GOSUB620:GOTO230      :rem 248
450 POKEC,18:GOSUB620:IFGE=0THENSC=SC+50:
    K=K+1:IFK=11THENGOTO560        :rem 251
460 IFGE=17THENSC=SC+100:POKEB,32:B=7905:
    B1=3                           :rem 149
470 IFGE=19THENSC=SC+10            :rem 129
480 IFA=CTHENSC=SC-100:A=7910:A1=3:POKEA,
    32                             :rem 34
490 POKEC,32:C=7679:GOTO180        :rem 67
500 POKE52,28:POKE56,28:POKE36879,236:POK
    E36869,240:CLR                 :rem 194
510 GOSUB630:PRINT"{10 DOWN}{5 SPACES}
    {RVS}HEAT SEEKER"              :rem 87
520 FORA=7168TO7327:READJ:POKEA,J:NEXT
                                   :rem 129
530 FORI=7336TOI+7:POKEI,PEEK(I-16):POKEI
    +88,0:NEXT:POKE36869,255       :rem 186
540 VO=36878:S2=36876:S4=36877:FORT=1TO8:
    READD(T):NEXT                  :rem 24
550 L=8:SC=0:K=0                   :rem 138
560 IFK=11THENL=L+1:K=0:SC=SC+1000
                                   :rem 245
570 GOSUB630:FORT=8142TO8163STEP2:POKET,0
    :NEXT                          :rem 171
580 FORT=8164TO8185:POKET,16:NEXT  :rem 42
590 FORT=1TORND(1)*4:POKE7724+INT(RND(1)*
    400),19:NEXT                   :rem 133
600 IFA<8164THENPOKEA,19           :rem 170
610 A=7910:A1=3:C=7679:B=7905:B1=3:POKEA,
    A1+7:GOTO110                   :rem 243
620 POKES4,190:FORT=100TO1STEP-5:POKEV0,T
    /7:NEXT:RETURN                 :rem 80
630 PRINT"{CLR}{BLK}";:FORI=0TO483:PRINT"
     ";:NEXT:PRINT"{RED}";:FORI=0TO20:PRI
    NT" ";:NEXT                    :rem 157
640 POKE38905,2:PRINT"{HOME}{BLK}";:RETUR
    N                              :rem 51
650 PRINT"{HOME}{RVS}SCORE:";SC;"{HOME}";
    SPC(13);"SHIPS:";L:RETURN      :rem 97
660 DATA 24,36,24,24,24,60,90,66   :rem 38
670 DATA 24,24,24,24,24,24,24,24   :rem 27
680 DATA 3,7,14,28,56,112,224,192  :rem 88
690 DATA 0,0,0,255,255,0,0,0       :rem 69
700 DATA 192,224,112,56,28,14,7,3  :rem 81
710 DATA 24,24,24,24,24,24,24,24   :rem 22
720 DATA 3,7,14,28,56,112,224,192  :rem 83
730 DATA 0,0,0,255,255,0,0,0       :rem 64
740 DATA 68,68,84,40,16,40,84,16   :rem 51
750 DATA 8,16,32,57,234,92,112,144
                                   :rem 139
760 DATA 0,0,71,40,212,40,71,0     :rem 168
770 DATA 144,112,92,234,57,32,16,8
                                   :rem 141
780 DATA 16,84,40,16,40,84,68,68   :rem 55
790 DATA 9,14,58,87,156,4,8,16     :rem 215
800 DATA 0,0,226,20,43,20,226,0    :rem 213
810 DATA 16,8,4,156,87,58,14,9     :rem 208
820 DATA 255,255,255,255,255,255,255,255
                                   :rem 200
830 DATA 129,90,36,60,36,24,36,195
                                   :rem 148
840 DATA 99,140,34,74,66,36,145,194
                                   :rem 208
850 DATA 231,165,219,36,36,219,165,231
                                   :rem 89
860 DATA -22,-21,1,23,22,21,-1,-23:rem 90
```

Program 2: Heat Seeker—64 Version

See instructions in article before entering program.

```
2049 :011,008,001,000,158,050,229
2055 :048,054,049,000,000,000,158
2061 :076,027,008,000,000,000,124
2067 :000,000,000,000,000,000,019
2073 :000,000,169,014,141,033,126
2079 :208,169,002,141,032,208,023
2085 :160,024,169,000,153,255,030
2091 :211,136,208,250,169,002,251
2097 :141,023,212,169,031,141,254
2103 :024,212,169,008,141,022,119
2109 :212,169,003,141,008,212,038
2115 :169,061,141,012,212,169,063
2121 :000,141,015,212,141,014,084
2127 :212,169,032,141,019,212,096
2133 :169,127,141,020,212,169,155
2139 :129,141,018,212,169,001,249
2145 :141,003,212,169,025,141,020
2151 :005,212,169,000,141,025,143
2157 :008,032,244,020,032,108,041
2163 :019,169,048,160,006,153,158
2169 :200,007,136,208,250,140,038
2175 :021,008,172,248,020,048,132
2181 :018,160,006,153,225,007,190
2187 :136,208,250,169,050,141,069
2193 :198,007,169,049,141,223,164
2199 :007,169,252,141,017,008,233
2205 :169,011,162,004,157,050,198
2211 :017,232,232,224,016,208,068
2217 :247,032,141,013,169,008,011
2223 :141,022,008,141,023,008,006
2229 :076,075,011,169,000,141,141
2235 :066,017,141,067,017,032,015
2241 :111,013,173,084,017,201,024
2247 :255,208,034,032,074,013,047
2253 :173,212,014,201,008,144,189
2259 :004,201,248,144,020,173,233
2265 :213,014,201,008,144,004,033
2271 :201,248,144,009,032,084,173
2277 :013,032,135,013,076,034,020
2283 :011,173,066,017,240,003,233
2289 :032,145,010,120,169,253,202
2295 :141,000,220,173,001,220,234
2301 :041,128,240,243,169,247,041
2307 :141,000,220,088,169,004,113
2313 :141,018,008,162,000,189,015
2319 :068,017,201,127,144,006,066
2325 :173,018,008,032,122,010,128
2331 :014,018,008,232,224,006,017
2337 :208,235,165,161,205,020,003
2343 :008,240,006,141,020,008,206
2349 :032,127,012,173,084,017,234
2355 :016,033,201,192,240,029,250
2361 :201,255,240,025,032,002,044
2367 :012,144,007,169,192,141,216
2373 :084,017,208,013,169,255,047
2379 :141,084,017,169,128,141,243
2385 :212,014,141,213,014,160,067
2391 :009,169,255,217,074,017,060
2397 :240,013,136,208,248,173,087
2403 :084,017,201,192,208,003,036
2409 :076,018,011,173,031,208,110
2415 :141,016,008,041,001,240,046
2421 :009,032,071,010,032,084,099
2427 :013,076,075,011,173,016,231
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2433 :008,041,002,240,003,032,199
2439 :033,010,173,016,008,041,160
2445 :252,208,003,076,192,008,112
2451 :141,016,008,169,004,141,114
2457 :019,008,170,173,019,008,038
2463 :045,016,008,240,003,032,247
2469 :179,009,014,019,008,232,114
2475 :232,224,016,208,236,076,139
2481 :192,008,045,016,208,240,118
2487 :002,056,036,024,189,000,234
2493 :208,106,056,233,008,176,208
2499 :002,169,000,201,160,144,103
2505 :002,169,144,074,074,074,226
2511 :074,168,185,074,017,201,158
2517 :255,208,072,169,192,153,238
2523 :074,017,169,000,157,034,158
2529 :017,157,035,017,169,226,078
2535 :157,001,208,189,000,208,226
2541 :056,233,016,041,224,024,063
2547 :105,028,157,000,208,032,005
2553 :154,012,138,074,170,169,198
2559 :064,157,066,017,169,255,215
2565 :157,248,007,138,010,170,223
2571 :032,063,013,152,010,010,035
2577 :168,169,096,153,113,007,211
2583 :153,114,007,153,153,007,098
2589 :153,154,007,096,173,084,184
2595 :017,201,255,208,030,032,010
2601 :181,012,032,063,013,169,255
2607 :000,141,036,017,141,037,163
2613 :017,141,084,017,169,226,195
2619 :141,003,208,169,002,141,211
2625 :040,208,032,084,013,096,026
2631 :169,000,141,034,017,141,061
2637 :035,017,169,226,141,001,154
2643 :208,169,002,141,039,208,082
2649 :169,001,013,028,208,141,137
2655 :028,208,032,135,013,032,031
2661 :063,013,160,192,132,162,055
2667 :173,031,208,041,002,240,034
2673 :003,032,033,010,164,162,005
2679 :208,242,096,013,017,008,191
2685 :141,017,008,173,018,008,234
2691 :073,255,045,021,208,141,106
2697 :021,208,169,254,157,250,172

2703 :007,096,173,067,017,201,192
2709 :028,176,006,169,000,141,157
2715 :066,017,096,173,017,008,020
2721 :208,001,096,169,000,141,008
2727 :066,017,141,067,017,169,132
2733 :004,170,168,045,017,008,073
2739 :208,010,152,010,168,232,191
2745 :232,224,016,208,242,096,179
2751 :141,018,008,013,021,208,088
2757 :141,021,208,173,018,008,254
2763 :073,255,168,045,017,008,001
2769 :141,017,008,173,016,208,004
2775 :041,001,240,012,173,018,188
2781 :008,013,016,208,141,016,111
2787 :208,076,238,010,152,045,188
2793 :016,208,141,016,208,173,227
2799 :034,017,157,034,017,173,159
2805 :035,017,157,035,017,173,167
2811 :000,208,157,000,208,173,229
2817 :001,208,157,001,208,138,202
2823 :074,168,169,000,153,066,125
2829 :017,088,076,090,013,174,215
2835 :021,008,254,022,008,160,236
2841 :010,032,181,012,136,208,092
2847 :250,240,041,169,000,141,104
2853 :034,017,141,036,017,141,167

2859 :035,017,141,037,017,032,066
2865 :063,013,173,028,208,009,031
2871 :001,141,028,208,169,002,092
2877 :141,039,208,141,040,208,070
2883 :169,192,133,162,165,162,026
2889 :208,252,120,169,100,141,039
2895 :000,208,169,100,141,001,186
2901 :208,169,000,141,016,208,059
2907 :169,001,141,021,208,169,032
2913 :240,141,248,007,169,015,149
2919 :141,039,208,169,254,045,191
2925 :028,208,141,028,208,169,123
2931 :000,133,160,133,161,133,067
2937 :162,141,020,008,032,111,083
2943 :019,162,009,169,255,157,130
2949 :074,017,202,016,250,169,093
2955 :000,141,084,017,173,031,073
2961 :208,173,030,208,044,248,032
2967 :020,048,028,160,009,185,089
2973 :197,007,170,185,222,007,177
2979 :153,197,007,138,153,222,009
2985 :007,136,208,239,169,001,161
2991 :056,237,021,008,141,021,147
2997 :008,174,021,008,189,022,091
3003 :008,208,019,160,000,044,114
3009 :248,020,048,001,200,185,127
3015 :022,008,208,202,136,016,023
3021 :248,076,188,012,222,022,205
3027 :008,189,022,008,024,105,055

3033 :049,141,214,007,173,001,034
3039 :220,045,000,220,041,016,253
3045 :208,246,173,001,220,045,098
3051 :000,220,041,016,240,246,230
3057 :169,000,141,035,017,141,232
3063 :036,017,169,085,141,034,217
3069 :017,088,076,184,008,160,018
3075 :009,185,074,017,201,255,232
3081 :240,013,136,016,246,169,061
3087 :253,045,021,208,141,021,192
3093 :208,056,096,169,192,153,127
3099 :074,017,152,010,010,168,202
3105 :169,096,153,113,007,153,212
3111 :114,007,153,153,007,153,114
3117 :154,007,152,010,010,010,132
3123 :072,144,010,169,002,013,205
3129 :016,208,141,016,208,208,086
3135 :008,169,253,045,016,208,250
3141 :141,016,208,104,024,105,155
3147 :028,141,002,208,169,226,081
3153 :141,003,208,169,247,141,222
3159 :249,007,169,171,141,037,093
3165 :017,173,031,208,044,017,071
3171 :208,048,251,173,018,208,237
3177 :201,242,208,244,169,007,152
3183 :141,040,208,169,002,013,172
3189 :021,208,141,021,208,173,121
3195 :031,208,024,096,072,138,180
3201 :072,162,005,254,200,007,061
3207 :169,058,221,200,007,208,230
3213 :008,169,048,157,200,007,218
3219 :202,208,238,104,170,104,149
3225 :096,072,138,072,173,205,141
3231 :007,024,105,005,201,058,047
3237 :176,005,141,205,007,208,139
3243 :234,233,010,141,205,007,233
3249 :162,004,208,207,072,138,200
3255 :072,162,004,208,200,120,181
3261 :169,049,141,020,003,169,228
3267 :234,141,021,003,088,169,083
3273 :048,141,214,007,032,132,007
3279 :255,160,016,185,046,013,114
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3285 :201,064,144,003,056,233,146
3291 :064,153,011,004,169,003,111
3297 :153,011,216,136,208,235,160
3303 :200,140,026,008,173,026,036
3309 :008,208,012,169,045,141,052
3315 :025,004,169,062,141,026,158
3321 :004,208,010,169,060,141,073
3327 :025,004,169,045,141,026,153
3333 :004,173,000,220,045,001,192
3339 :220,074,074,074,176,005,122
3345 :160,001,140,026,008,074,170
3351 :176,005,160,000,140,026,018
3357 :008,074,176,202,032,129,138
3363 :255,173,026,008,240,003,228
3369 :076,027,008,133,198,000,227
3375 :080,076,065,089,032,065,198
3381 :071,065,073,078,063,032,179
3387 :089,032,032,078,169,128,075
3393 :141,011,212,169,129,141,100
3399 :011,212,096,169,255,056,102
3405 :237,003,208,141,015,212,125
3411 :096,169,000,141,015,212,204
3417 :096,169,024,141,025,008,040
3423 :165,162,141,024,008,169,252
3429 :064,141,004,212,169,065,244
3435 :141,004,212,096,165,162,119
3441 :205,024,008,240,016,141,235
3447 :024,008,173,025,008,201,046
3453 :048,176,007,141,001,212,198
3459 :238,025,008,096,169,000,155
3465 :141,001,212,096,076,153,048
3471 :013,011,000,000,000,000,167
3477 :000,000,000,000,120,169,182
3483 :171,141,020,003,169,013,160
3489 :141,021,003,169,014,141,138
3495 :005,220,088,096,173,000,237
3501 :220,045,001,220,141,146,178
3507 :013,173,034,017,013,035,208
3513 :017,208,003,076,195,014,186
3519 :173,146,013,041,016,208,020
3525 :003,238,066,017,173,146,072
3531 :013,041,003,201,003,208,160
3537 :003,076,195,014,173,144,046
3543 :013,141,145,013,173,034,222
3549 :017,141,149,013,048,003,080
3555 :169,000,044,169,255,141,237
3561 :150,013,160,008,136,014,202
3567 :145,013,144,250,192,000,215
3573 :240,037,014,149,013,046,232
3579 :150,013,014,145,013,144,218
3585 :023,024,173,149,013,109,236
3591 :034,017,141,149,013,144,249
3597 :003,238,150,013,173,034,112
3603 :017,016,003,206,150,013,168
3609 :136,208,219,173,146,013,152
3615 :041,002,208,022,056,173,021
3621 :148,013,237,149,013,141,226
3627 :148,013,173,035,017,237,154
3633 :150,013,141,035,017,076,225
3639 :076,014,024,173,148,013,247
3645 :109,149,013,141,148,013,122
3651 :173,035,017,109,150,013,052
3657 :141,035,017,173,144,013,084
3663 :141,145,013,173,035,017,091
3669 :141,151,013,048,003,169,098
3675 :000,044,169,255,141,152,084
3681 :013,160,008,136,014,145,061
3687 :013,144,250,192,000,240,174
3693 :037,014,151,013,046,152,010
3699 :013,014,145,013,144,023,211
3705 :024,173,151,013,109,035,114
3711 :017,141,151,013,144,003,084
3717 :238,152,013,173,035,017,249
3723 :016,003,206,152,013,136,153
3729 :208,219,173,146,013,041,177
3735 :002,208,022,024,173,147,215
3741 :013,109,151,013,141,147,219
3747 :013,173,034,017,109,152,149
3753 :013,141,034,017,076,195,133
3759 :014,056,173,147,013,237,047
3765 :151,013,141,147,013,173,051
3771 :034,017,237,152,013,141,013
3777 :034,017,076,198,014,076,096
3783 :216,014,008,000,000,000,181
3789 :000,000,000,000,000,000,205
3795 :000,000,000,000,000,173,128
3801 :000,208,056,237,002,208,160
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3879 :141,212,014,076,069,015,054
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3939 :002,044,169,003,141,210,156
3945 :014,169,000,044,213,014,047
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3957 :014,169,001,208,010,044,051
3963 :212,014,016,003,169,002,027
3969 :044,169,003,141,211,014,199
3975 :173,210,014,056,237,211,012
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3987 :141,203,014,076,034,016,119
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4395 :000,000,000,000,000,000,043
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4521 :046,105,017,014,101,017,213
4527 :144,046,024,173,102,017,169
4533 :125,034,017,141,102,017,105
4539 :144,003,238,103,017,189,113
4545 :034,017,016,003,206,103,060
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4557 :035,017,141,104,017,144,151

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4719 :201,250,144,002,169,250,103

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4743 :067,017,162,005,254,068,196
4749 :017,202,016,250,173,084,115
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4761 :173,036,017,208,013,173,005
4767 :037,017,208,008,169,255,085
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4797 :017,076,202,018,201,224,159
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4851 :169,010,201,006,208,002,071
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4863 :249,007,173,034,017,208,175
4869 :013,173,035,017,208,008,203
4875 :169,255,141,248,007,076,139
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4887 :017,173,034,017,048,012,068
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4929 :141,107,017,076,084,019,253
4935 :201,224,176,009,024,169,106
4941 :009,109,107,017,141,107,055
4947 :017,173,107,017,201,004,090
4953 :208,002,169,010,201,006,173
4959 :208,002,169,011,024,105,102
4965 :230,141,248,007,076,049,084
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5055 :253,202,208,243,240,008,065
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5067 :230,253,230,254,208,002,100
5073 :230,255,165,252,201,064,096
5079 :208,208,169,254,141,028,199
5085 :208,165,001,041,251,133,252
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5097 :153,000,048,185,000,221,072
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5121 :000,050,200,192,032,208,171
5127 :245,160,000,152,153,000,205
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5145 :133,253,169,000,133,254,199
5151 :133,252,168,169,096,145,226
5157 :254,169,008,145,252,200,041
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5169 :165,255,201,007,208,235,096
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5193 :160,000,169,254,153,250,035
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5217 :007,160,000,185,186,020,143
5223 :201,064,144,003,056,233,036
5229 :064,153,192,007,169,003,185
5235 :153,192,219,200,044,248,147
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5349 :189,149,020,153,152,007,131
5355 :200,202,208,240,192,040,037

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5391 :073,128,157,231,004,032,128
5397 :086,022,240,030,189,231,051
5403 :004,073,128,157,231,004,112
5409 :152,024,109,247,020,201,018

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5433 :020,024,105,004,141,050,145
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5445 :105,003,141,201,014,105,126
5451 :001,141,144,013,169,002,033
5457 :205,247,020,208,003,238,234
5463 :144,013,169,255,141,248,033
5469 :020,160,025,162,026,169,143
5475 :022,032,073,022,173,248,157
5481 :020,010,170,232,232,189,190
5487 :044,005,073,128,157,044,050
5493 :005,032,086,022,240,035,025
5499 :024,109,248,020,189,044,245
5505 :005,073,128,157,044,005,029
5511 :152,024,109,248,020,201,121
5517 :254,208,002,169,255,201,206
5523 :001,208,002,169,000,141,156
5529 :248,020,076,103,021,160,013
5535 :021,162,051,169,022,032,104
5541 :073,022,032,086,022,208,096
5547 :251,096,197,032,201,032,212
5553 :206,032,058,084,082,069,196
5559 :080,088,069,032,044,069,053
5565 :084,065,073,068,069,077,113
5571 :082,069,084,078,073,032,101
5577 :044,069,067,073,086,079,107
5583 :078,032,017,013,045,084,220
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5619 :083,085,032,017,013,053,014
5625 :056,057,049,032,033,069,033
5631 :084,085,080,077,079,195,087
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5655 :155,017,147,014,050,032,182
5661 :049,032,058,083,082,069,146
5667 :089,065,076,080,032,070,191
5673 :079,032,082,069,066,077,190
5679 :085,078,032,017,013,078,094
5685 :073,071,069,066,032,079,187
5691 :084,032,069,082,073,070,213
5697 :032,083,083,069,082,080,238
5703 :017,013,134,254,133,255,109
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5739 :252,173,000,220,045,001,030
5745 :220,041,004,208,003,160,237
5751 :255,096,173,000,220,045,140
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5763 :160,001,096,173,000,220,013
5769 :045,001,220,041,016,208,156
5775 :220,160,000,096,000,008,115
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5787 :001,063,192,000,001,063,219
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5811 :063,000,002,063,000,002,053
5817 :063,000,002,062,000,002,058
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5835 :048,000,009,012,000,002,018
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5859 :252,000,002,252,000,002,223
5865 :124,000,002,060,000,002,165
5871 :060,000,002,060,000,002,107
5877 :124,000,001,001,252,000,111
5883 :001,003,252,000,001,003,255
5889 :216,000,001,003,000,027,248
5895 :224,000,002,248,000,002,227
5901 :126,003,224,063,255,252,168
5907 :127,255,255,063,255,255,205
5913 :000,055,255,255,252,255,073
5919 :255,254,063,255,252,007,093
5925 :192,126,000,002,031,000,132
5931 :002,007,000,022,003,000,077
5937 :002,007,000,002,015,000,075
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5949 :002,063,128,000,001,015,014
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5967 :224,000,001,015,224,000,031
5973 :001,003,248,000,002,248,075
5979 :000,002,060,000,002,012,167
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6015 :000,001,063,000,002,060,253
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6027 :000,002,060,000,002,252,199
6033 :000,001,003,254,000,001,148
6039 :015,254,000,001,063,159,131
6045 :000,001,254,007,003,248,158
6051 :000,001,015,248,000,001,172
6057 :063,240,000,001,063,192,216
6063 :000,032,048,000,002,060,061
6069 :000,002,031,000,002,031,247
6075 :192,000,001,007,240,000,115
6081 :001,007,252,000,001,001,199
6087 :255,000,002,031,192,000,167
6093 :001,007,240,000,001,001,199
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6129 :041,104,000,001,009,096,236
6135 :000,001,009,096,000,001,098
6141 :001,064,000,001,001,064,128
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6153 :001,064,000,001,001,064,140
6159 :000,032,001,064,000,001,113
6165 :001,064,000,001,001,064,152
6171 :000,001,001,064,000,001,094
6177 :001,064,000,001,009,096,204
6183 :000,001,009,096,000,001,146
6189 :041,104,000,001,041,104,080
6195 :000,001,040,040,000,001,133
6201 :040,040,000,035,170,000,086
6207 :002,170,128,000,001,021,129
6213 :085,000,001,021,085,000,005
6219 :001,021,085,000,001,170,097
6225 :128,000,001,170,000,046,170
6231 :170,000,001,002,170,000,174
6237 :001,085,084,000,001,085,093
6243 :084,000,001,085,084,000,097
6249 :001,002,170,000,002,170,194
6255 :000,044,008,000,002,010,175
6261 :000,002,006,128,000,001,254
6267 :021,128,000,001,165,064,246
6273 :000,001,041,080,000,001,252
6279 :010,084,000,002,021,000,252
6285 :002,005,000,039,005,000,192
6291 :002,021,000,001,010,084,009
6297 :000,001,041,080,000,001,020
6303 :165,064,000,001,021,128,026
6309 :000,001,006,128,000,001,045
6315 :010,000,002,008,000,040,231
6321 :032,000,002,160,000,001,116
6327 :002,144,000,001,002,084,160
6333 :000,001,001,090,000,001,026
6339 :005,104,000,001,021,160,230
6345 :000,001,084,000,002,080,112
6351 :000,039,080,000,002,084,156
6357 :000,002,021,160,000,001,141
6363 :005,104,000,001,001,090,164
6369 :000,001,002,084,000,001,057
6375 :002,144,000,002,160,000,027
6381 :002,032,000,026,008,128,177
6387 :000,001,010,168,000,001,167
6393 :043,224,000,001,011,224,240
6399 :000,001,011,232,000,001,244
6405 :042,160,000,001,002,032,242
6411 :000,051,136,000,001,002,201
6417 :170,000,001,002,174,000,108
6423 :001,002,238,128,010,255,145
6429 :160,010,255,224,011,254,175
6435 :168,011,255,224,042,255,222
6441 :168,043,255,224,043,255,005
6447 :232,011,255,224,047,255,047
6453 :160,042,255,224,047,255,012
6459 :248,043,187,224,010,170,173
6465 :168,255,013,013,013,013,028
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Power BASIC: Quick Character Transfer

(Article on page 109.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Quick Character Transfer—64 Version

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90 POKE56,14*4:CLR:POKE53272,(PEEK(53272)
   AND240)OR14                          :rem 222
100 AD=828:REM STARTING ADDRESS         :rem 133
110 FORI=ADTOAD+81:READA:X=X+A:POKEI,A:NE
    XTI                                  :rem 75
120 IFX<>9923THENPRINT"ERROR IN DATA STAT
    EMENTS.":STOP                       :rem 188
130 SYSAD                                :rem 24
140 DATA 173,14,220,41,254,141,14       :rem 70
150 DATA 220,173,24,208,41,14,10        :rem 18
160 DATA 10,133,167,169                 :rem 107
170 DATA 208:REM CHANGE TO 216 TO MOVE LO
    WER CASE                            :rem 203
180 DATA 133,252,173,0,221,41,3,73,3
                                        :rem 216
```

```
190 DATA 10,10,10,10,10,10,5        :rem 55
200 DATA 167,133,254,165,1,41,251   :rem 78
210 DATA 133,1,169,0,133,251,133    :rem 19
220 DATA 253,168,162,8,177,251,145
                                    :rem 145
230 DATA 253,200,208,249,230,252,230
                                    :rem 223
240 DATA 254,202,208,242,165,1,9    :rem 31
250 DATA 4,133,1,173,14,220,9       :rem 130
260 DATA 1,141,14,220,96            :rem 145
1000 FORI=14336TO14343:READA:POKEI,A:NEXT
                                     :rem 0
1010 DATA 60,66,165,129,165,153,66,60
                                    :rem 33
```

Program 2: Quick Character Transfer—VIC Version

```
90 POKE56,28:CLR:POKE36869,255     :rem 245
100 AD=828:REM STARTING ADDRESS    :rem 133
110 FORI=ADTOAD+38:READA:POKEI,A:X=X+A:NE
    XT                              :rem 4
120 IFX<>6044THENPRINT"ERROR IN DATA STAT
    EMENTS.":STOP                  :rem 179
130 SYSAD                           :rem 24
140 DATA 173,5,144,41,3,10,10      :rem 122
150 DATA 105,16,133,254,169         :rem 47
160 DATA 128:REM 132,136, OR 140 FOR OTHE
    R CHAR SETS                    :rem 238
170 DATA 133,252,169,0,133,251,133
                                   :rem 128
180 DATA 253,168,162               :rem 221
190 DATA 2:REM CHANGE TO 6 TO MOVE 192 CH
    ARS                            :rem 106
200 DATA 177,251,145,253           :rem 155
210 DATA 200,208,249,230,252,230,254
                                   :rem 222
220 DATA 202,208,242,96            :rem 103
1000 FORI=7168TO7175:READA:POKEI,A:NEXT
                                   :rem 170
1010 DATA 60,66,165,129,165,153,66,60
                                   :rem 33
```

Program 3: Quick Character Transfer—Plus/4 and 16 Version

```
90 POKE56,60:CLR
100 AD=819:REM STARTING ADDRESS
110 FORI=ADTOAD+31:READ A:POKEI,A:X=X+A:N
    EXT
120 IFX<>5848THENPRINT"ERROR IN DATA STAT
    EMENTS.":STOP
130 SYSAD
140 DATA 169
150 DATA 60:REM HIGH BYTE OF CHAR SET DES
    TINATION
160 DATA 133,254,169,208:REM CHANGE 208 T
    O 212 TO MOVE LOWER CASE
170 DATA 133,252,169,0,133,251,133
180 DATA 253,168,162,4,177,251,145
190 DATA 253,200,208,249,230,252,230
200 DATA 254,202,208,242,96
210 POKE65298,PEEK(65298)AND251
220 POKE65299,PEEK(65299)AND3OR60
1000 FORI=15360TO15367:READA:POKEI,A:NEXT
1010 DATA 60,66,165,129,165,153,66,60
```

Digger

(Article on page 60.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Digger—VIC Version

```
4097 :011,016,001,000,158,052,239
4103 :049,049,048,000,000,000,153
4109 :000,076,228,025,169,143,142
4115 :141,015,144,169,255,141,116
4121 :005,144,169,111,141,014,097
4127 :144,162,000,169,031,157,182
4133 :000,030,169,003,157,000,140
4139 :150,232,224,066,208,241,140
4145 :162,000,169,030,157,066,121
4151 :030,157,000,031,169,008,194
4157 :157,066,150,157,000,151,230
4163 :232,208,237,234,162,000,116
4169 :173,040,145,201,022,176,062
4175 :249,160,000,217,060,003,000
4181 :240,242,200,192,007,208,150
4187 :246,157,060,003,232,224,245
4193 :006,208,229,162,000,173,107
4199 :040,145,201,019,176,249,165
4205 :160,000,217,067,003,240,028
4211 :242,200,192,007,208,246,186
4217 :157,067,003,232,224,006,042
4223 :208,229,096,234,234,234,082
4229 :162,000,188,067,003,185,226
4235 :000,017,133,001,185,020,239
4241 :017,133,002,188,060,003,036
4247 :169,000,145,001,165,002,121
4253 :024,105,120,133,002,169,198
4259 :008,145,001,232,224,003,008
4265 :208,220,230,247,165,247,206
4271 :201,002,144,004,169,000,183
4277 :133,247,162,000,189,046,190
4283 :017,208,036,188,070,003,197
4289 :185,000,017,133,001,185,202
4295 :020,017,133,002,188,063,110
4301 :003,189,043,017,024,101,070
4307 :247,145,001,165,002,024,027
4313 :105,120,133,002,189,040,038
4319 :017,145,001,232,224,003,077
4325 :208,210,173,049,017,208,070
4331 :010,169,010,133,000,032,077
4337 :000,018,032,133,018,076,006
4343 :179,018,169,224,141,049,003
4349 :017,096,234,066,088,110,096
4355 :132,154,176,198,220,242,101
4361 :008,030,052,074,096,118,131
4367 :140,162,184,206,228,030,197
4373 :030,030,030,030,030,030,201
4379 :030,030,031,031,031,031,211
4385 :031,031,031,031,031,031,219
4391 :031,001,003,005,003,003,085
4397 :003,000,000,000,000,000,048
4403 :251,251,251,016,016,016,084
4409 :000,000,000,000,000,000,057
4415 :032,032,032,032,032,032,255
```

```
4421 :032,033,035,032,000,051,252
4427 :018,051,179,059,247,204,065
4433 :238,212,206,174,197,172,000
4439 :204,237,092,204,202,172,174
4445 :204,180,232,204,236,093,218
4451 :072,192,205,076,146,104,126
4457 :196,200,206,092,198,216,189
4463 :204,050,134,053,171,118,073
4469 :119,051,224,051,005,019,074
4475 :011,051,243,050,195,179,084
4481 :031,187,059,162,242,049,091
4487 :010,034,030,055,145,113,010
4493 :083,058,049,094,207,196,060
4499 :139,076,076,140,200,105,115
4505 :132,236,196,143,220,085,141
4511 :076,206,204,140,076,140,233
4517 :207,238,235,204,140,220,129
4523 :205,204,206,140,072,115,089
4529 :023,147,053,049,131,055,123
4535 :205,050,193,114,066,177,220
4541 :101,019,179,063,133,051,223
4547 :122,098,181,115,002,051,252
4553 :169,055,063,091,107,035,209
4559 :042,196,036,079,204,201,197
4565 :200,204,140,236,204,092,009
4571 :209,204,204,204,204,204,168
4577 :233,205,220,205,136,234,178
4583 :232,094,132,204,194,140,203
4589 :236,204,206,050,115,050,074
4595 :023,035,019,119,147,039,113
4601 :179,058,059,049,230,243,043
4607 :240,173,066,003,141,080,190
4613 :003,173,073,003,141,081,223
4619 :003,169,127,141,034,145,118
4625 :173,032,145,041,128,208,232
4631 :025,169,014,133,000,238,090
4637 :080,003,173,080,003,201,057
4643 :022,208,003,206,080,003,045
4649 :169,255,141,034,145,076,093
4655 :132,018,169,255,141,034,028
4661 :145,173,017,145,041,016,078
4667 :208,020,169,012,133,000,089
4673 :206,080,003,173,080,003,098
4679 :201,255,208,003,238,080,032
4685 :003,076,132,018,173,017,240
4691 :145,041,008,208,020,169,162
4697 :016,133,000,238,081,003,048
4703 :173,081,003,201,020,208,013
4709 :003,206,081,003,076,132,090
4715 :018,173,017,145,041,004,249
4721 :208,017,169,018,133,000,146
4727 :206,081,003,173,081,003,154
4733 :201,255,208,003,238,081,087
4739 :003,096,238,050,017,173,196
4745 :050,017,201,002,144,005,044
4751 :169,000,141,050,017,172,180
4757 :081,003,185,000,017,133,056
4763 :001,185,020,017,133,002,001
4769 :172,080,003,177,001,201,027
4775 :028,176,005,096,234,234,172

4781 :234,234,032,217,018,096,236
4787 :172,073,003,185,000,017,117
4793 :133,001,185,020,017,133,162
4799 :002,172,066,003,165,000,087
4805 :024,109,050,017,145,001,031
4811 :165,002,024,105,120,133,240
4817 :002,169,008,145,001,076,098
4823 :250,018,172,073,003,185,148
4829 :000,017,133,001,185,020,065
4835 :017,133,002,172,066,003,108
4841 :169,029,145,001,173,080,062
4847 :003,141,066,003,173,081,194
4853 :003,141,073,003,096,160,209
4859 :000,162,000,232,208,253,082
4865 :200,192,064,208,246,162,049
4871 :000,188,067,003,200,192,145
4877 :020,240,042,185,000,017,005
4883 :133,001,185,020,017,133,252
4889 :002,188,060,003,177,001,200
4895 :201,030,208,018,169,251,140
4901 :157,051,017,076,058,019,159
4907 :068,073,071,071,069,082,221
4913 :234,076,058,019,169,255,092
4919 :157,057,017,232,224,003,233
4925 :208,201,162,000,189,057,110
4931 :017,240,088,189,054,017,160
4937 :240,006,234,222,054,017,078
4943 :208,077,188,067,003,200,054
4949 :192,020,240,054,185,000,008
4955 :017,133,001,185,020,017,208
4961 :133,002,188,060,003,177,148
4967 :001,201,030,240,035,188,030
4973 :067,003,185,000,017,133,002
4979 :001,185,020,017,133,002,217
4985 :188,060,003,169,029,145,203
4991 :001,254,067,003,189,051,180
4997 :017,141,012,144,222,051,208
5003 :017,076,158,019,169,000,066
5009 :157,057,017,169,016,157,206
5015 :054,017,169,255,141,060,079
5021 :017,232,224,003,208,158,231
5027 :162,000,189,057,017,201,021
5033 :255,240,010,232,224,003,109

5039 :208,244,169,000,141,012,181
5045 :144,032,074,022,076,223,240
5051 :019,169,005,157,043,017,085
5057 :076,223,020,169,003,157,073
5063 :043,017,076,223,020,234,044
5069 :234,234,234,234,234,234,073
5075 :234,234,234,234,234,234,079
5081 :234,234,234,234,234,234,085
5087 :162,000,189,060,003,205,074
5093 :066,003,208,011,189,067,005
5099 :003,205,073,003,208,003,218
5105 :076,189,023,232,224,003,220
5111 :208,232,076,025,020,152,192
5117 :072,138,072,162,004,254,187
5123 :062,017,189,062,017,201,039
5129 :042,208,008,169,032,157,113
5135 :062,017,202,208,238,104,078
5141 :170,104,168,096,173,060,024
5147 :017,240,026,206,060,017,081
5153 :173,060,017,201,252,240,208
5159 :008,169,224,141,013,144,226
5165 :076,056,020,169,000,141,251
5171 :013,144,141,060,017,234,148
5177 :234,234,230,248,165,248,136
5183 :201,003,144,004,169,000,072
5189 :133,248,166,248,189,046,075
5195 :017,240,003,076,253,020,172
5201 :189,063,003,133,249,189,139
5207 :070,003,133,250,165,162,102
5213 :041,001,240,063,165,249,084
5219 :205,066,003,240,056,176,077
5225 :027,230,249,164,250,185,186
5231 :000,017,133,001,185,020,211
5237 :017,133,002,164,249,177,091
5243 :001,201,010,176,002,198,199
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5249 :249,076,188,019,198,249,084
5255 :164,250,185,000,017,133,116
5261 :001,185,020,017,133,002,243
5267 :164,249,177,001,201,010,181
5273 :176,002,230,249,076,196,058
5279 :019,165,250,205,073,003,106
5285 :240,086,144,027,198,250,086
5291 :164,250,185,000,017,133,152
5297 :001,185,020,017,133,002,023
5303 :164,249,177,001,201,010,217
5309 :176,002,230,250,076,223,122
5315 :020,230,250,164,250,185,014
5321 :000,017,133,001,185,020,045
5327 :017,133,002,164,249,177,181
5333 :001,201,010,176,002,198,033
5339 :250,076,223,020,188,070,022
5345 :003,185,000,017,133,001,052
5351 :185,020,017,133,002,188,008
5357 :063,003,169,029,145,001,135
5363 :165,250,157,070,003,165,029
5369 :249,157,063,003,032,150,135
5375 :023,162,000,189,046,017,180
5381 :208,019,189,063,003,205,180
5387 :066,003,208,011,189,070,046
5393 :003,205,073,003,208,003,000
5399 :076,189,023,232,224,003,002
5405 :208,227,173,049,017,240,175
5411 :004,076,019,022,234,173,051
5417 :017,145,041,032,240,003,007
5423 :076,019,022,173,066,003,150
5429 :141,080,003,173,073,003,014
5435 :141,081,003,165,000,201,138
5441 :010,240,235,165,000,201,148
5447 :012,208,013,169,001,141,103
5453 :082,003,169,255,141,083,042
5459 :003,076,133,021,201,014,019
5465 :208,011,169,001,141,082,189
5471 :003,141,083,003,076,133,022
5477 :021,201,016,208,013,169,217
5483 :002,141,082,003,169,001,249
5489 :141,083,003,076,133,021,058
5495 :201,018,208,007,169,002,212
5501 :141,082,003,169,255,141,148
5507 :083,003,173,082,003,201,164
5513 :001,240,003,076,209,021,175
5519 :162,005,173,080,003,024,078
5525 :109,083,003,201,022,144,199
5531 :003,076,019,022,141,080,240
5537 :003,172,081,003,185,000,093
5543 :017,133,001,185,020,017,028
5549 :133,002,172,080,003,177,228
5555 :001,201,029,240,003,076,217
5561 :121,022,173,082,003,145,219
5567 :001,165,002,024,105,120,096
5573 :133,002,169,000,145,001,135
5579 :202,208,195,076,016,022,154
5585 :162,005,173,081,003,024,145
5591 :109,083,003,201,020,144,007
5597 :003,076,019,022,141,081,051
5603 :003,172,081,003,185,000,159
5609 :017,133,001,185,020,017,094
5615 :133,002,172,080,003,177,038
5621 :001,201,029,240,003,076,027
5627 :121,022,173,082,003,145,029
5633 :001,165,002,024,105,120,162
5639 :133,002,169,000,145,001,201
5645 :202,208,195,032,249,016,147
5651 :076,130,022,165,002,024,182
5657 :105,120,133,002,162,000,035
5663 :189,046,017,208,026,177,182
5669 :001,221,040,017,208,019,031
5675 :169,003,157,046,017,142,065
5681 :084,003,169,255,141,049,238
5687 :017,032,252,019,076,072,011
5693 :022,232,224,003,208,220,202
5699 :169,255,141,084,003,096,047
5705 :234,162,000,160,000,185,046
5711 :046,017,208,027,189,060,114
5717 :003,217,063,003,208,019,086
5723 :189,067,003,217,070,003,128
5729 :208,011,169,255,141,060,173
5735 :017,153,046,017,032,252,108
5741 :019,200,192,003,208,219,182
5747 :232,224,003,208,212,096,066
5753 :032,249,016,032,022,022,238
5759 :234,234,234,234,234,234,251
5765 :173,049,017,240,055,165,064
5771 :197,201,063,208,026,169,235
5777 :253,141,013,144,206,049,183
5783 :017,173,049,017,041,004,196
5789 :208,016,174,084,003,048,178
5795 :011,254,046,017,076,175,230
5801 :022,169,000,141,013,144,146
5807 :173,049,017,201,239,208,038
5813 :011,169,000,141,049,017,056
5819 :141,013,144,032,196,022,223
5825 :076,234,022,164,000,185,106
5831 :044,030,201,001,240,004,207
5837 :201,002,208,005,169,029,051
5843 :153,044,030,185,000,031,142
5849 :201,001,240,004,201,002,098
5855 :208,005,169,029,153,000,019
5861 :031,200,208,221,096,162,123
5867 :000,189,046,017,240,032,247
5873 :201,255,240,028,234,188,107
5879 :070,003,185,000,017,133,143
5885 :001,185,020,017,133,002,099
5891 :188,063,003,189,046,017,253
5897 :074,074,234,024,105,007,015
5903 :145,001,232,224,003,208,060
5909 :214,173,049,017,240,025,227
5915 :173,049,017,201,225,176,100
5921 :018,206,049,017,173,049,033
5927 :017,201,222,208,008,032,215
5933 :196,022,169,000,141,049,110
5939 :017,234,173,049,017,208,237
5945 :021,162,000,189,046,017,236
5951 :240,013,201,255,240,009,253
5957 :165,162,197,161,176,003,165
5963 :222,046,017,232,224,003,051
5969 :208,233,162,000,189,046,151
5975 :017,201,255,208,008,232,240
5981 :224,003,208,244,076,233,057
5987 :023,162,000,189,063,017,041
5993 :201,032,240,003,076,117,006
5999 :023,232,224,004,208,241,019
6005 :157,004,030,232,189,063,024
6011 :017,224,005,208,245,162,216
6017 :000,189,046,017,201,255,069
6023 :208,005,169,026,157,022,210
6029 :030,232,224,003,208,239,053
6035 :076,236,025,189,046,017,224
6041 :208,033,188,070,003,185,072
6047 :000,017,133,001,185,020,003
6053 :017,133,002,188,063,003,059
6059 :189,043,017,145,001,165,219
6065 :002,024,105,120,133,002,051
6071 :189,040,017,145,001,096,159
6077 :169,000,141,012,144,141,028
6083 :013,144,169,255,141,011,160
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6089 :144,162,016,160,000,136,051
6095 :208,253,202,208,248,206,252
6101 :011,144,173,011,144,201,129
6107 :144,208,236,169,000,141,093
6113 :011,144,076,014,016,234,208
6119 :234,234,169,000,141,012,253
6125 :144,141,013,144,162,000,073
6131 :188,067,003,185,000,017,191
6137 :133,001,185,020,017,133,226
6143 :002,188,060,003,169,000,165
6149 :145,001,165,002,024,105,191
6155 :120,133,002,169,008,145,076
6161 :001,234,234,234,234,234,164
6167 :232,224,003,208,215,160,041
6173 :000,169,026,153,022,030,173
6179 :200,192,003,208,248,169,031
6185 :240,141,010,144,169,207,184
6191 :141,011,144,169,175,141,060
6197 :012,144,162,010,032,252,153
6203 :019,202,208,250,162,000,132
6209 :160,000,136,208,253,202,000
6215 :208,248,162,000,169,000,090
6221 :157,046,017,232,224,003,244
6227 :208,248,173,073,017,201,235
6233 :021,240,003,238,073,017,169
6239 :169,000,141,010,144,141,188
6245 :011,144,141,012,144,234,019
6251 :234,234,234,234,234,234,231
6257 :169,000,141,060,017,032,020
6263 :017,016,032,163,024,076,191
6269 :133,016,002,187,071,227,249
6275 :169,000,141,073,017,162,181
6281 :000,169,032,157,063,017,063
6287 :232,224,005,208,246,169,203
6293 :000,141,049,017,162,000,006
6299 :157,046,017,232,224,003,066
6305 :208,248,169,020,141,000,179
6311 :030,169,021,141,001,030,047
6317 :169,022,141,002,030,169,194
6323 :023,141,003,030,169,024,057
6329 :141,011,030,169,025,141,190
6335 :012,030,169,000,141,073,104
6341 :003,169,011,141,066,003,078
6347 :162,000,189,063,017,221,087
6353 :068,017,240,005,144,024,195
6359 :076,226,024,232,224,005,234
6365 :208,238,076,239,024,162,144
6371 :000,189,063,017,157,068,209
6377 :017,232,224,005,208,245,140
6383 :162,000,189,068,017,201,108
6389 :032,240,003,076,000,025,109
6395 :232,224,004,208,241,157,037
6401 :014,030,232,189,068,017,039
6407 :224,005,208,245,174,073,168
6413 :017,240,009,169,027,157,120
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6437 :030,202,076,006,025,096,216
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6467 :208,244,076,130,025,000,238
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6737 :207,235,215,000,201,000,171
6743 :215,000,201,000,215,000,206
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6989 :165,148,208,245,189,182,190
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7259 :255,255,125,060,040,010,068
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7271 :010,010,006,006,015,063,213
7277 :055,163,010,160,144,144,017
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7289 :144,144,240,252,220,202,043
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7307 :255,255,125,044,008,040,098
7313 :040,040,255,255,125,044,136
7319 :008,040,040,040,255,255,021
7325 :125,056,032,255,255,248,104
7331 :247,249,254,241,255,255,128
7337 :255,198,189,189,189,198,107
7343 :255,255,255,099,173,163,095
7349 :171,109,255,255,255,031,233
7355 :127,063,127,031,255,255,021
7361 :255,107,106,010,106,107,116
7367 :255,255,255,022,246,144,096
7373 :214,022,255,255,247,249,167
7379 :240,226,195,013,134,243,238
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7391 :127,040,040,040,040,040,038
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7415 :017,255,255,255,255,255,003
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7433 :231,215,247,247,247,193,109
7439 :255,195,189,253,243,207,077
7445 :191,129,255,195,189,253,209
7451 :227,253,189,195,255,251,117
7457 :243,235,219,129,251,251,081
7463 :255,129,191,135,251,253,229
7469 :187,199,255,227,223,191,047
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7487 :255,195,189,189,195,189,251
7493 :189,195,255,195,189,189,001
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7511 :000,011,015,001,015,000,129
7517 :000,000,000,000,143,000,236
7523 :000,096,000,000,000,000,195
7529 :141,128,000,000,000,000,118
7535 :000,000,012,195,230,122,158
7541 :208,002,230,123,173,008,093
7547 :002,201,058,176,010,201,003
7553 :032,240,239,056,233,048,209
7559 :056,233,208,096,128,079,167
7565 :199,082,088,000,255,000,253
7571 :000,000,000,000,016,000,163
7577 :000,003,000,000,128,000,028
7583 :000,000,105,135,000,000,143
7589 :000,000,000,000,000,000,165
7595 :000,000,000,000,000,000,171
7601 :000,060,003,000,000,000,240
7607 :000,000,000,000,000,000,183
7613 :000,000,000,000,124,108,165
7619 :000,029,015,000,000,007,246
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7631 :000,021,154,030,007,000,163
7637 :021,007,048,000,158,158,093
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49170 :141,020,003,169,192,141,172
49176 :021,003,173,026,208,009,208
49182 :001,141,026,208,096,169,159
49188 :001,141,025,208,162,093,154
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49236 :208,076,101,192,173,017,083
49242 :208,041,223,141,017,208,160
49248 :169,021,141,024,208,169,060
49254 :001,141,026,208,173,013,152
49260 :220,041,001,240,003,076,177
49266 :049,234,076,188,254,169,060
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49290 :205,162,000,189,009,208,143
49296 :201,235,208,011,232,232,239
49302 :224,007,144,243,169,001,170
49308 :141,131,205,173,021,208,011
49314 :041,014,208,005,169,002,089
49320 :141,131,205,174,130,205,130
49326 :189,008,208,157,067,205,240
49332 :173,016,208,061,196,192,002
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49344 :205,076,206,192,016,000,119
49350 :032,000,064,169,000,157,108
49356 :068,205,056,189,067,205,226
49362 :233,016,157,067,205,189,053
49368 :068,205,233,000,157,068,179
49374 :205,056,189,009,208,233,098
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49392 :173,233,203,072,173,189,003
49398 :204,072,173,249,203,072,195
49404 :165,253,072,165,254,072,209
49410 :189,083,205,141,233,203,032
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49422 :189,068,205,141,218,203,014
49428 :138,072,032,167,199,104,220
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49464 :254,009,208,032,118,193,102
49470 :076,070,193,169,050,157,009
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49494 :233,203,104,141,218,203,164
49500 :104,141,217,203,238,130,101
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49512 :205,201,007,176,003,076,004
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49524 :205,096,173,021,208,141,192
49530 :171,204,173,119,205,041,011
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49554 :205,185,249,197,013,064,035
49560 :205,045,171,204,141,021,171
49566 :208,032,239,193,173,030,009
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49578 :204,141,155,204,104,240,194
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49596 :073,255,045,171,204,141,053
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49608 :001,141,131,205,173,171,254
49614 :204,205,021,208,240,026,086
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49668 :141,128,039,160,000,177,137
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49680 :056,165,251,233,063,141,157
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49770 :205,032,250,193,032,113,163
49776 :196,032,091,195,173,030,061
49782 :208,032,043,194,032,119,234
49788 :192,032,136,197,032,069,014
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50094 :205,208,020,232,189,032,036
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50106 :032,196,141,008,212,232,239
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50118 :162,024,105,006,197,162,086
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50130 :212,141,011,212,173,137,072
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50160 :010,049,028,011,030,025,137
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50172 :015,096,022,017,030,025,201
50178 :018,135,033,019,135,033,119
50184 :020,135,033,021,135,033,129
50190 :022,030,025,024,030,025,170
50196 :026,049,028,027,030,025,205
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50208 :001,097,008,010,071,006,225
50214 :011,012,007,012,233,007,064
50220 :013,097,008,015,233,007,161
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50340 :028,162,003,024,032,240,141
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50532 :140,140,160,000,185,025,238
50538 :201,153,000,032,200,208,132
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50550 :153,000,033,200,208,247,191
50556 :160,000,185,025,203,153,082
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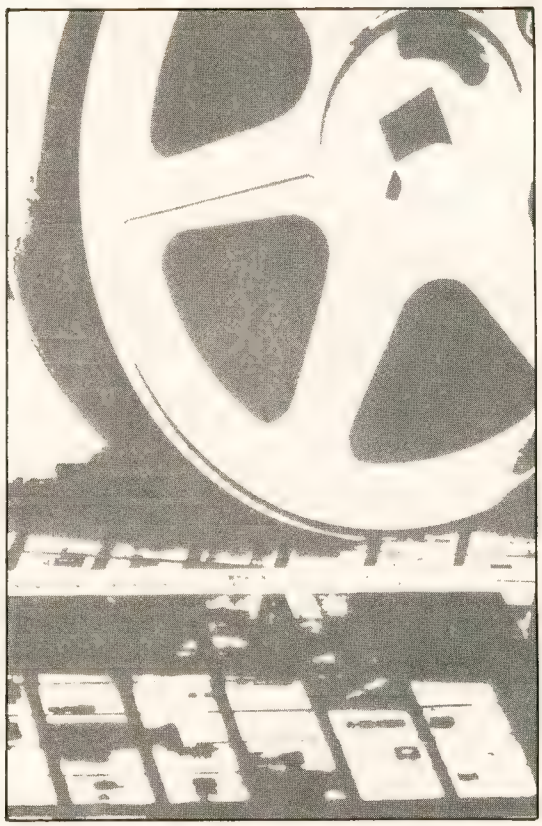

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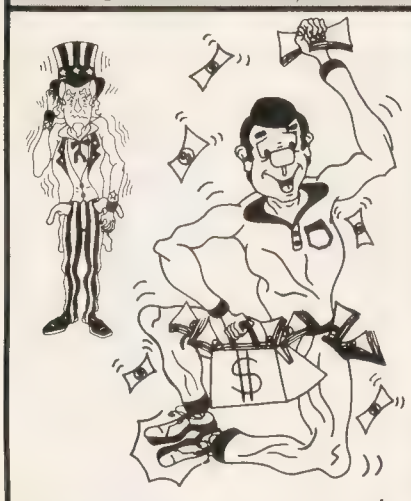

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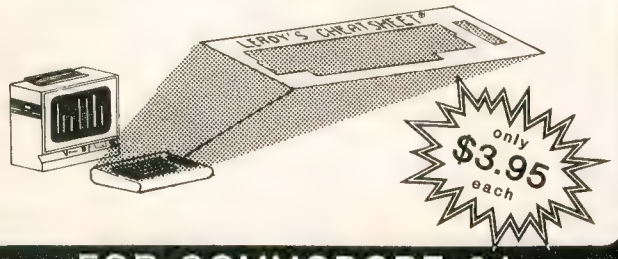

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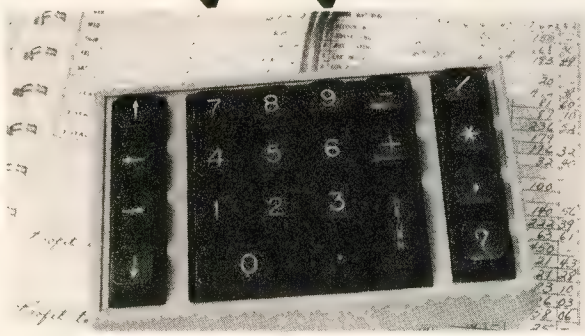

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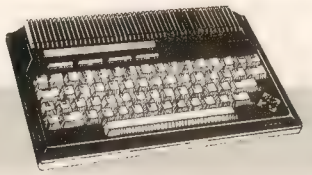

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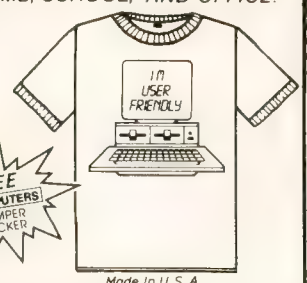

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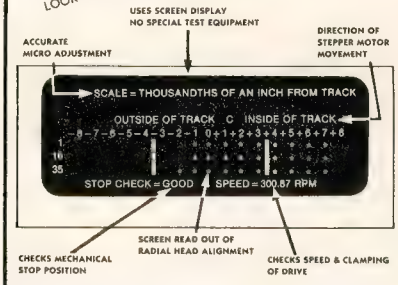

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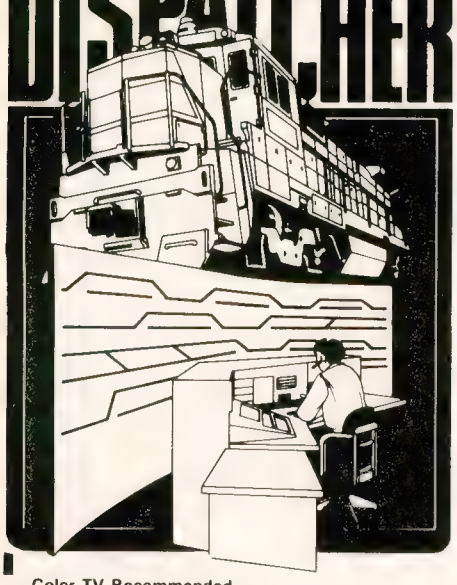

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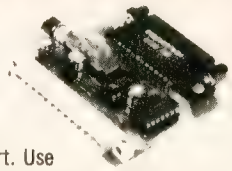

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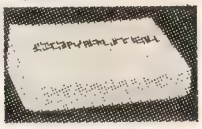

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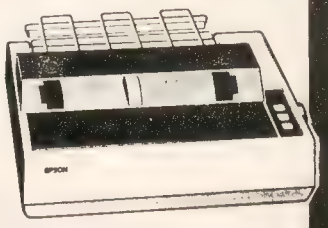

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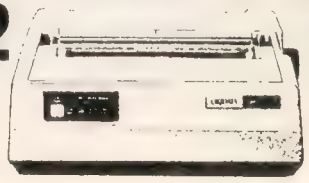

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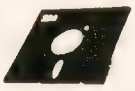

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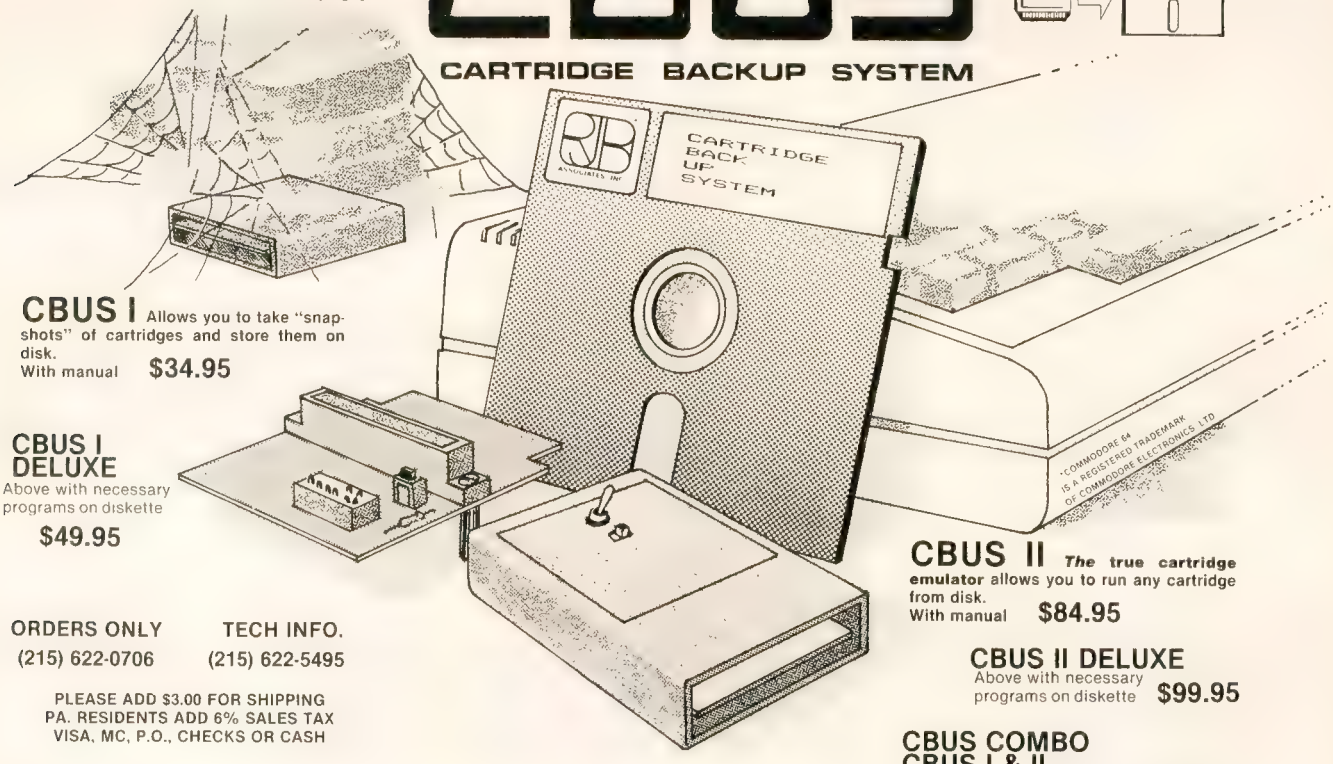

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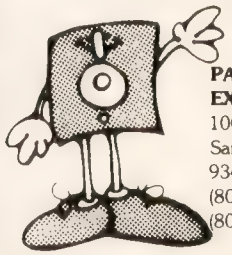

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6:30

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7:00

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7:30

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8:00

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8:30

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9:00

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9:30

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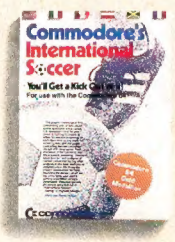

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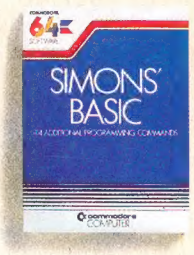
10:00

SIMONS' BASIC



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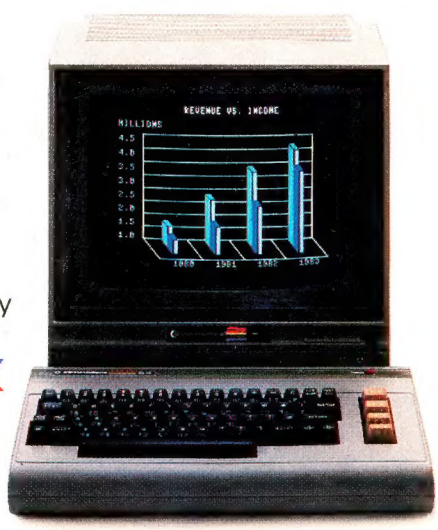

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